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ARMSTRONG LABORATORY

WASTEWATER/STORM WATER CHARACTERIZATION SURVEY, WILLOW GROVE AIR RESERVE FACILITY, PENNSYLVANIA

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OCCUPATIONAL AND ENVIRONMENTAL
HEALTH DIRECTORATE
Brooks Air Force Base, TX 78235-5000

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Final Technical Report for Period 15–26 July 1991

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A wastewater characterization survey was conducted at Willow Grove Air Reserve Facility from 15-26 July 1991 by personnel from the Water Quality Function of Armstrong Laboratory. Quantitative data were also collected after a rain event to assess the quality of the water in the storm water holding pond. Sampling of the oil/water separators was also performed and recommendations were made concerning good management practices to implement to maintain the separators.

Slight contamination of the wastewater discharged from the Facility was found, indicating the base is using good shop practices to minimize the disposal of industrial wastes through the sanitary sewer system. Results of the storm water sampling showed that the quality of the water in the holding pond was not greatly impacted by storm water runoff from the industrial areas on the Facility. A recommendation was made to install a pollution control device on the drain at the Bulk Fuels Storage Area. One oil/water separator was found to contain oil that had hazardous waste characteristics. All others had oil that was suitable for energy recovery.

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WASTEWATER/STORM WATER CHARACTERIZATION SURVEY, WILLOW GROVE AIR RESERVE FACILITY, PENNSYLVANIA

INTRODUCTION

A wastewater characterization survey was conducted at the Willow Grove Air Reserve Facility (ARF) from 15 to 26 July 1991 by personnel of the Occupational and Environmental Health Directorate (OEHD), Armstrong Laboratory. Quantitative data were also collected after a rain event as background information for the base in assessing the quality of the storm water runoff from a holding pond. In addition, the oil/water separators identified by base personnel were sampled and recommendations were made concerning their proper maintenance.

This survey was performed by the OEHD Water Quality Function in response to a request from HQ Air Force Reserve (AFRES). The request is at Appendix A. As a result of an external Environmental Compliance and Management Program (ECAMP) audit, the base requested a survey to determine whether the wastewater discharged by the ARF requires pretreatment in accordance with the National Pollutant Discharge Elimination System (NPDES).

Armstrong Laboratory personnel performing the survey included Capt Richard McCoy, TSgt Mary Fields, and SSgt Pete Davis.

DISCUSSION

Background

Willow Grove Air Reserve Facility is situated 10 miles (16 km) north of the Philadelphia city limits in Willow Grove, Pennsylvania. The facility, a tenant on Willow Grove Naval Air Station (NAS), which flies the P-3 Orion aircraft, is responsible for submarine surveillance and antisubmarine warfare. In addition, the NAS hosts a Marine Reserve unit that flies the A-4 attack plane, and an Army National Guard unit that flies helicopters. The ARF, situated on the northeast corner of the NAS, consists of the 913th Tactical Air Group, an AFRES component which flies C-130 tactical airlift aircraft, and the 111th Tactical Air Group, an Air National Guard (ANG) unit that flies the A-10 aircraft in combat support. The facility also hosts the 270th Electronic Installation Squadron (EIS), which is a deployable unit that installs telephone and power cable in field situations, and the 31st Military Aerial Port Squadron that packages and ships materiel.

The ARF employs 268 full-time personnel and trains 779 personnel on Unit Training Activity (UTA) weekends. The ANG has 251 full-time personnel and trains 804 personnel on UTA weekends. The UTAs for the AFRES and ANG are normally staggered to alleviate overcrowding on the small facility. However, during the 20-21 July 1991 UTA, both units held training.

Wastewater Characterization Survey

Wastewater treatment is conducted by Naval Air Station personnel. The wastewater treatment plant (WWTP) on Willow Grove NAS uses a primary clarifier to pump solids to an anaerobic digester. Secondary treatment is accomplished with trickling filters. The effluent is chlorinated prior to discharging it to Pennypacker Creek. Residual chlorine levels are monitored after chlorination and at the entrance to the creek.

Permit Standards

The discharge from the WWTP is regulated by a NPDES Permit (Permit #PA0022411). The permit regulates the quantity and concentration of certain pollutants, as listed in Table 1. The base has generally not had any problems meeting the requirements of this permit.

Sampling Strategy

A presurvey was conducted at Willow Grove ARF from 28 to 29 May 1991. During this presurvey, the sampling protocol that had been developed by Capt McCoy was reviewed with the base Bioenvironmental Engineer, Mr. Bach, and the sampling sites were inspected for access and flow. A copy of the sampling strategy is at Appendix B. A map showing the locations of the wastewater sampling sites is shown in Figure B-1. The only change to the strategy that occurred during the survey was the addition of oil/water separator sampling at the request of Lt Colonel Rothert, 111th TAC/DE, and Mr Bach.

Sampling Methods

Wastewater samples were typically collected over a 24-hour period as time-proportional composites (i.e., a daily composite of 24 samples collected at 1-hour intervals). The automated composite samplers (Figure 1) contain a 3-gallon (11.4-liter) glass jar which was packed in ice before each day of sampling. The jars were replaced with clean jars each day.

The two most important sample collection sites are Site 10, WWTP effluent (Figure 2), and Site 6, Lift Station (Figure 3). Site 10 was chosen to determine if the NAS WWTP was adequately treating the wastewater before discharge off-base, and Site 6 was chosen to characterize the aggregate wastewater stream as it left the ARF.

The sample pH and temperature were recorded at the site each day a sample was collected. Also, any unusual characteristics (odor, color, etc.) of the composite or grab samples were noted. Samples of volatile organics, oils and greases, total petroleum hydrocarbons, and total toxic organics were collected as grab samples (Figure 4).

The wastewater samples were then placed in iced coolers and transported back to the workcenter (ANG Civil Engineering Plumbing Shop, Bldg 232) for preservation and/or refrigeration until shipment to the

TABLE 1. WILLOW GROVE NAS NPDES PERMIT DISCHARGE LIMITATIONS

Parameter	Monthly Average Quantity or Loading: English Units	Monthly Average Quantity or Loading: Metric Units	Monthly Average Quality or Concentration	Frequency of Analysis
Flow	1 MGD	3,785 m^3/day	-----	Continuous
CBOD5 1 May - 31 Oct	83 lb/day	37 kg/day	10 mg/l	1/week
CBOD5 1 Nov - 30 Apr	167 lb/day	76 kg/day	20 mg/l	1/week
Suspended Solids	250 lb/day	114 kg/day	30 mg/l	1/week
Ammonia as N 1 May - 31 Oct	12 lb/day	5.5 kg/day	1.5 mg/l	1/week
Ammonia as N 1 Nov - 30 Apr	25 lb/day	11.4 kg/day	3.0 mg/l	1/week
Fecal Coliform	----		200/100ml	1/week
Dissolved Oxygen	----		5.0 mg/l minimum	1/day
pH	----		6.0 - 9.0	1/day
Phosphorus as P	17 lb/day	7.7 kg/day	2.0 mg/l	1/week
Nitrite and Nitrate Nitrogen 1 Jul - 31 Oct	79 lb/day	36 kg/day	9.5 mg/l	1/week

Figure 1. Typical Sample Collection Procedures.

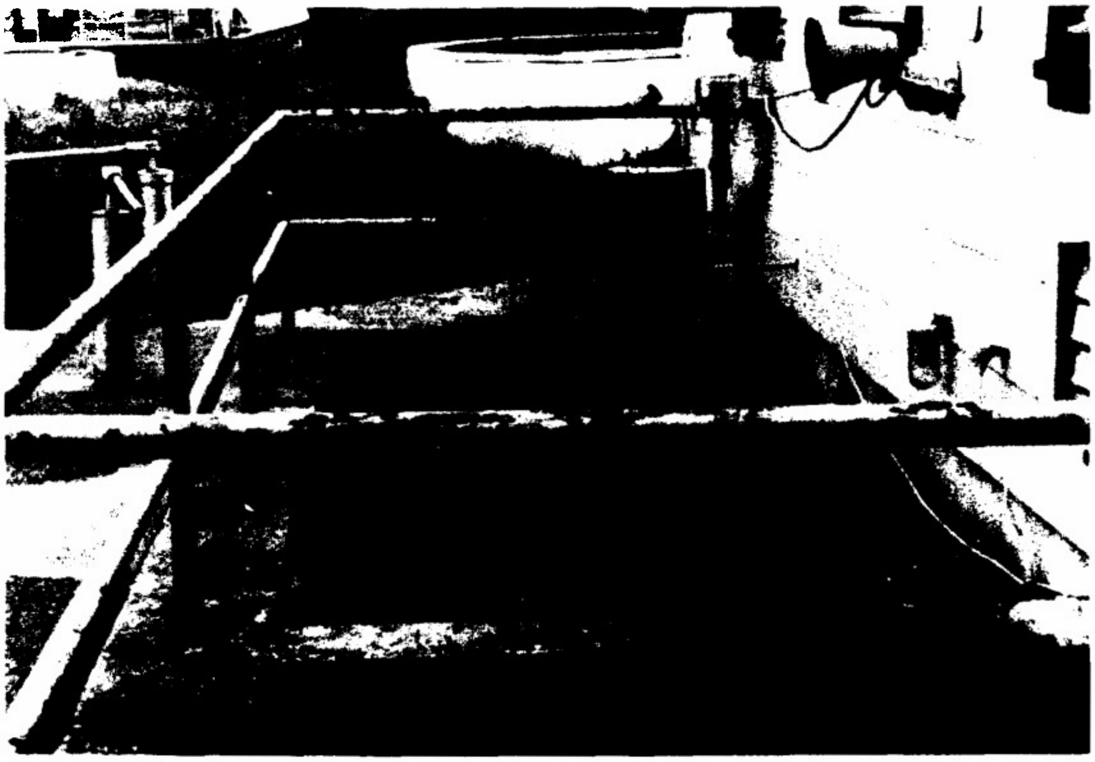

Figure 2. Sample Collection Point for Site 10, WWTP.

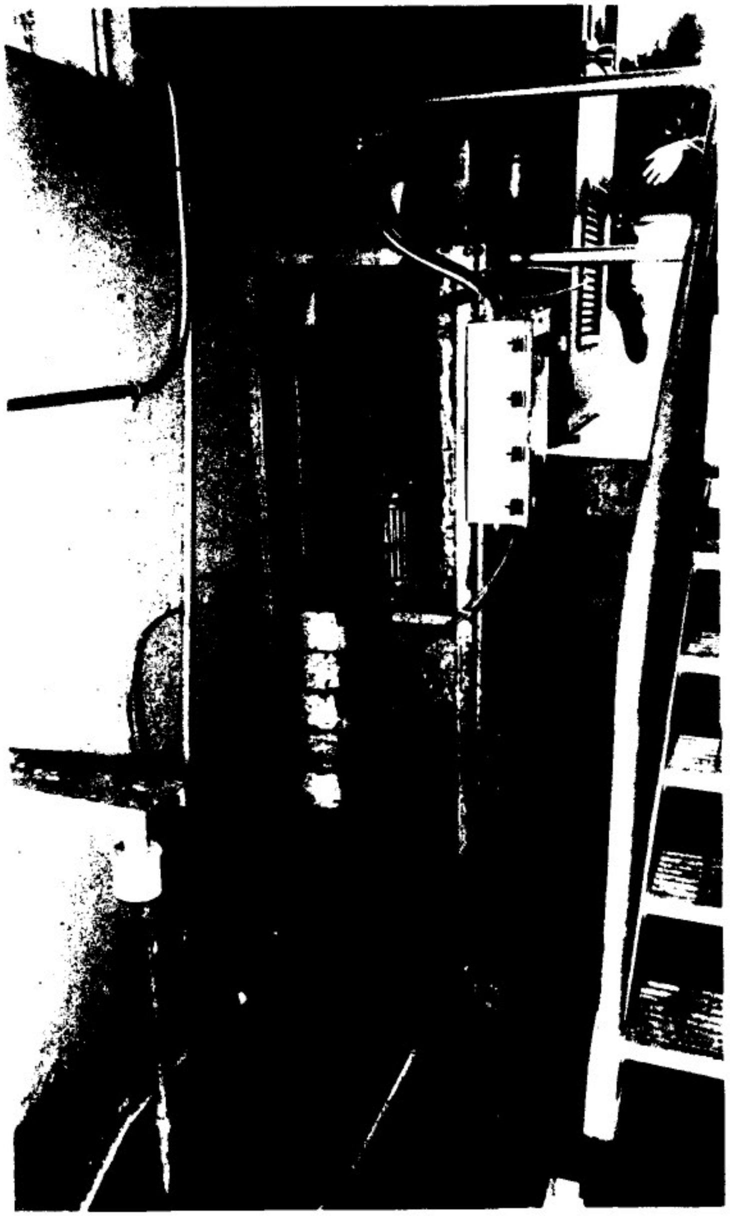

Figure 3. Sample Collection Point for Site 6, Lift Station.

Figure 4. Collection of VOC Samples.

analytical laboratory. Sample preservation was in accordance with the AFOEHL Sampling Guide, March 1990. Table 2 lists the analyses and preservation methods used for the samples taken during this survey.

All hazardous waste samples from the oil/water separators were collected as grab samples. Table 3 shows the analysis and preservation methods used to analyze these samples. The samples analyzed for 8 total metals required no special preservation. The volatile samples were refrigerated after collection and then transported back to the analytical laboratory in iced coolers.

Field Quality Assurance/Quality Control (QA/QC)

A field QA/QC program was used during this survey to verify the accuracy and reproducibility of laboratory results. This program involved collecting field blank and duplicate samples. Twenty percent of the samples taken during this survey were QA/QC samples. Samples sent for analysis were submitted as single-blind samples (i.e., the laboratory did not know which samples were QA/QC samples). The QA/QC results for the blank samples are shown in Appendix C. Results of duplicate samples for volatile organics, total metals, and other analyses are shown in Appendixes D-F, respectively.

Equipment Blank Samples. Equipment blank samples were collected at randomly selected sites using laboratory-grade distilled water. These samples are as free of contaminants as possible and are preserved in the same manner as the normal samples. They serve as a check on the sample team's technique and possible cross contamination due to the sampling equipment. The results of the equipment blank analyses are shown in Tables C-1, C-2, and C-3. Table C-1 shows some contamination of the volatile organic chemicals analyses by carbon tetrachloride (0.62 µg/l) and tetrachloroethylene (2.6 µg/l). These levels may be a result of a laboratory artifact or grab sample equipment contamination. The equipment blank for oils and greases, shown in Table C-3, showed a slight level of 0.3 mg/l oils and greases. These slight contamination problems are most likely due to contamination from the composite sampler tubing.

Reagent Blanks. Reagent blanks are made with laboratory-grade distilled water in the laboratory. They are preserved as regular samples and serve as a check on the purity of the preservatives. The reagent blanks for metals (Table C-2) and other analytes (Table C-3) showed no contamination due to the preservatives.

Duplicate Samples. Duplicate samples were collected as well-mixed samples taken from the 3-gallon (11.4-liter) collection jar (for composite samples) or from a well-mixed rinsed stainless steel pitcher (for grab samples). Duplicate samples serve as a measure of precision, which is agreement between a set of replicate measurements without assumption or knowledge of the true value.

Tables D-2, D-4, D-8, and D-10 show the results of duplicate samples for volatile organics taken on 20 and 24 July 1991. Very good agreement was found in all duplicate samples. The variations in

TABLE 2. WASTEWATER ANALYSES AND PRESERVATION METHODS

Analysis	Preservation	EPA Method	Holding Time (days)
Purgeable Aromatics (VOAs)	4°C	602	14
Purgeable Hydrocarbons (VOHs)	4°C	601	14
Total Metals			
Arsenic	HNO_3	206.2	180
Barium	HNO_3	200.7	180
Beryllium	HNO_3	210.1	180
Boron	HNO_3	200.7	180
Cadmium	HNO_3	213.1	180
Calcium	HNO_3	215.1	180
Chromium	HNO_3	218.1	180
Chromium (VI)	HNO_3	218.1	180
Copper	HNO_3	220.1	180
Iron	HNO_3	236.1	180
Lead	HNO_3	239.1	180
Magnesium	HNO_3	242.1	180
Manganese	HNO_3	243.1	180
Mercury	HNO_3	245.1	180
Molybdenum	HNO_3	200.7	180
Nickel	HNO_3	249.1	180
Potassium	HNO_3	258.1	180
Selenium	HNO_3	270.2	180
Silver	HNO_3	272.1	180
Thallium	HNO_3	279.2	180
Zinc	HNO_3	289.1	180
Cyanide	NaOH	335.3	14
Ammonia	H_2SO_4, 4°C	350.1	28
Phenols	H_2SO_4, 4°C	420.2	28
Oils & Greases	H_2SO_4, 4°C	413.2	28
Phosphorus, Total	H_2SO_4, 4°C	365.1	28
Hydrocarbons, Total Petroleum	H_2SO_4, 4°C	418.1	28
Total Toxic Organics	4°C	624	14
Total Toxic Organics	4°C	625, 608	7

NOTES: 4°C = Chilled to 4°C
HNO_3 = Add nitric acid to pH < 2.0
H_2SO_4 = Add sulfuric acid to pH < 2.0
NaOH = Add sodium hydroxide to pH > 12.0

TABLE 3. HAZARDOUS WASTE ANALYSES AND PRESERVATION METHODS

Analysis	Preservation	EPA Method	Holding Time (days)
Total Metals			
Arsenic	None	3020/7060	180
Barium	None	3010/7080	180
Cadmium	None	3010/7130	180
Chromium	None	3010/7190	180
Lead	None	3010/7420	180
Mercury	None	7470	28
Selenium	None	3020/7740	180
Silver	None	3010/7760	180
Flashpoint	None	1010	180
PCBs	4°C	8080	7
(Includes: Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260)			
pH	None	1110	14
Purgeable Aromatic Hydrocarbons			
Toluene	4°C	503.1	14
Xylenes	4°C	SW8020	14
Benzene	4°C	503.1	14
1,4-Dichlorobenzene	4°C	503.1	14
1,2-Dichlorobenzene	4°C	503.1	14
1,3-Dichlorobenzene	4°C	503.1	14

NOTES: 4°C = Chilled to 4°C

1,3-dichlorobenzene concentrations at Site 7 (3 versus 0.6 µg/l) and tetrachloroethylene concentrations at Site 9 (2.1 versus 3.8 µg/l) are within the precision limits of the field precision described in the EPA Method.

Tables E-2 and E-4 show the results of duplicate samples for the total metals analyses. Most of the analyses showed good agreement between the duplicates. However, at Site 1, total arsenic results showed poor agreement (less than 10 µg/l versus 57 µg/l) and at Site 3 the precision of the total boron and iron analyses was poor. This poor agreement reflects the difficulty in obtaining true field duplicates for total metals in wastewater since small particles usually found in sewage can have metals adsorbed onto them that slowly dissolve into the aqueous phase.

Results of other duplicate samples taken for the miscellaneous analyses listed in Appendix F showed generally good agreement. In Table F-1, the precision of the oils and greases results was not good. This poor agreement can be expected due to the difficulty of splitting a sample in the field that has a floating or suspended contaminant such as oils and greases. The duplicate total petroleum hydrocarbon samples were within an order of magnitude of each other. The duplicate samples taken for ammonia and cyanide showed excellent agreement.

Analytical QA/QC. In addition to the field QA/QC program, both the OEHD Analytical Services Division of Armstrong Laboratory and the contract laboratory used to analyze the Total Toxic Organics (TTO) and oil/water separator hazardous waste samples have in-house QA/QC programs that follow guidance established by the Environmental Protection Agency (EPA). Any questions concerning these QA/QC procedures should be addressed to the Analytical Services Division at DSN 240-3626.

Storm Water Sampling

In November 1990, the EPA published new storm water regulations to comply with the Clean Water Act (CWA), Section 402p (1). The CWA required EPA to establish regulations under the NPDES Permit program. The rules regulate certain industrial and municipal discharges of storm water. This regulation requires industrial storm water dischargers to apply for a permit either individually or as part of a group of similar industries by October 1992. Organizations that apply for a group application must show that activities at their geographically separated units are similar in both activities performed and chemical usage and storage. If the EPA agrees that the group is similar, then only a representative sample population (10-20%) of the sites need to perform quantitative sampling by October 1992. Based on the results of the sampling, chemical specific permits will be issued for all the sites under the group application. The Air Force Reserve has applied as a group, and Willow Grove ARF is located on one of the bases that will conduct quantitative sampling by October 1992.

We conducted sampling on 24 July 1991 at the holding pond (Figure 5) after a storm event. The holding pond receives storm water runoff from virtually all the industrial areas of the ARF via storm sewers and drainage

Figure 5. Site 11, Storm Water Holding Pond.

Figure 6. Drainage Ditch to Storm Water Holding Pond.

ditches (Figure 6). This sampling was done to provide background information on the quality of the storm water discharged by the facility. Guidance from the storm water regulation was used in performing this sampling, though not all of the requirements of the law were strictly followed. For instance, detailed information concerning the usage and storage of hazardous materials was not collected and used in developing a sampling strategy. In addition, we did not survey the base intensely to determine the number and location of all possible storm water discharges from the base.

Sampling Strategy

The storm water regulation describes the mandatory analyses that must be performed. First, samples must be collected from the discharge resulting from a storm event that is greater than 0.1 inch (0.254 cm) and at least 72 hours from the previously measurable (also greater than 0.1 inch [0.254 cm]) storm event. Where feasible, the variance in the duration of the event and the total rainfall of the event should not exceed 50% from the average or median rainfall event in that area. One grab sample may be taken for storm water discharges from holding ponds or other impoundments with a retention period greater than 24 hours.

Quantitative data must be reported for the following pollutants:

1. Any pollutant limited in an effluent guideline to which the facility is subject.

2. Oil and grease, pH, total suspended solids, chemical oxygen demand, 5-day carbonaceous biochemical oxygen demand (CBOD5), total phosphorus, total Kjeldahl nitrogen, and nitrate- plus nitrite-nitrogen.

3. Other pollutants the applicant is expected to know or has reason to believe are present based on an evaluation of the expected use, production, or storage of the pollutant, or on any previous analyses for the pollutant.

The sampling performed during this survey included the pollutants listed in paragraphs 1 and 2 above, as well as volatile organics (EPA Methods 601 and 602) and heavy metals screen.

Oil/Water Separator Testing and Analysis

During this survey, 11 oil/water separators were inspected, sampled for hazardous constituents in any existing oil layer, and, if possible, performance tested. This testing was done for the AFRES and ANG units in support of a project to pump out all the separators. A copy of the contractor's bid and statement of work is included in Appendix H. Since the quoted price for the required analyses per separator was approximately $550, this sampling would save the base over $6,000. The locations of these separators are depicted in Figure H-1. Site descriptions and sample collection notes are given in Table 4.

TABLE 4. OIL/WATER SEPARATOR SITE DESCRIPTIONS AND SAMPLING NOTES.

Site #	Bldg. #	Tank #	Sampling Notes
12	201	3	Underground tank full of rusty water.
13	201	2	Steel interceptor enclosed in concrete vault. Could not get to oil reservoir. Dry well full of water. Access pipe nearby was dry down to 50 feet.
14	232	17	Sump hole in Plumbing Shop. Grit collection tray. Black oil floating above it. Outfall side had clear water in it (outside of shop).
15	237	7	4" diameter hole in ground. Noted an onion-like smell. Took outfall side sample from what looked like a grit chamber. Had a handle down in it that looked like a power cable.
16	238	25	Another 4" diameter hole. Noted a strong fuel smell. No outfall side could be found.
17	353	19	EIS Motorpool Waterfall Paint Spray Booth.
18	231	16	Fuels Lab. 2" pipe immediately behind center of building. Pumped sample for hazardous waste analysis. Noted a strong fuel odor.
19	230	13	Fuel Cell Repair. Typical oil/water separator design. Influent and outfall sides easy to discern.
20	350	30	ANG Refueling Vehicle Maintenance. Fenced in. Hole to holding tank was beside the building. There was a grit chamber in the shop floor. A heavy oil and fuel smell was evident.
21	320	29	Inside fenced area that was locked. Just a sump with an inverted elbow for discharge. No floating oil evident.
22	330	8	Steel separator enclosed in concrete vault. Could not open 2" access pipe. The vault was half full of water.

Sampling Strategy

The sampling cited in the contractor's bid was for 8 heavy metals, polychlorinated biphenyls (PCBs), benzene/toluene/ethylbenzene/xylene (BTEX), flashpoint, and pH. We collected samples for hazardous waste analysis when we found a separator with a floating oil layer. If we were able to discern the configuration of the influent and outfall sides of the separator, we collected water samples from each side to determine if the unit was adequately separating oil from the water phase.

RESULTS

Wastewater Characterization Survey

Flow Measurements

Estimates of flow from the ARF to the NAS WWTP were obtained by recording the Lift Station pumping times for each day of sampling. Using the number of minutes of pumping each day and multiplying by 36,000 gallons per minute (136 m^3), the approximate volume of wastewater discharged by the ARF could be estimated. Table 5 shows the amount of wastewater discharged by the ARF during the survey.

TABLE 5. FLOW DATA FOR WILLOW GROVE ARF DISCHARGE

Date	Flow (gallons per day)	Flow (cubic meters/day)
18 Jul 91	18,360	69.5
19 Jul 91	26,280	99.5
20 Jul 91	23,040	87.2
21 Jul 91	29,160	110.4
22 Jul 91	30,600	115.8
23 Jul 91	20,520	77.7
24 Jul 91	38,880	147.2

It should be noted that the significant increase in flow recorded on 24 July 1991 was probably due to intrusion of rainwater into the sewer system from a rain event the prior day.

Volatile Organic Chemicals

Volatile organic chemical (VOC) results are shown in Appendix D. Table D-1 shows the existing criteria that were used to evaluate the results of the sampling. The EPA has established three types of criteria for VOCs in water. These are the standards set by the Safe Drinking Water Act (SDWA) (2), the Water Quality Criteria for Water (3), and the NPDES Industrial Pretreatment Standards (4). It should be noted that, when these standards are applied to wastewater, none of these criteria are currently enforceable on federal facilities under Federal law. They are simply being used here for the sake of comparison.

The SDWA, promulgated in 1976, authorized the EPA to establish regulations and conduct studies concerning safe levels of contaminants in drinking water. The contaminant concentrations permitted under the SDWA represent maximum concentrations of contaminants under which it is believed that no adverse health effects will occur in the general population.

The Water Quality Criteria Document was developed to comply with Section 304(a)(1) of the CWA. These criteria reflect the latest scientific knowledge (a) on the kind and extent of all identifiable effects on health and welfare to plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, aesthetics, and recreation which may be expected from the presence of pollutants in any body of water including ground water; (b) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, or chemical processes; and (c) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and organic and inorganic sedimentation for varying types of receiving waters. These criteria are not rules and they do not have regulatory impact. Rather, these criteria present scientific data and guidance concerning the environmental effects of pollutants which can be useful to derive regulatory requirements based on considerations of water quality impacts (3).

The Industrial Pretreatment Standards, which fall under the NPDES Permitting Program, impose general prohibitions on industrial dischargers to Publicly Owned Treatment Works (POTWs) and specific prohibitions on industrial dischargers which fall into specific categories of industries (4). At this time, federal facilities that perform wastewater treatment on-site have not been subject to the categorical industry standards because federally-owned WWTPs do not fall under the definition of a POTW. This gap in the definition is expected to be closed soon through the court system.

The general prohibitions on discharges from industrial users include (a) pollutants which create a fire or explosion hazard, (b) pollutants which will cause corrosive structural damage to the POTW, (c) solid or viscous pollutants in amounts which will obstruct flow in the POTW resulting in interference, (d) any pollutant, including oxygen-demanding pollutants released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW, and (e) heat levels which will inhibit biological activity in the POTW resulting in interference (4).

Categorical discharge limitations established by the Industrial Pretreatment Standards have been promulgated for certain categories of industries. The industrial categories under which typical U.S. Air Force operations may fall include electroplating, metal finishing, photographic processing, and hospitals. Though no organic chemical manufacturing operations occur on Willow Grove ARF, the pretreatment standards for this categorical industry are included since they cite standards for VOCs.

Tables D-2 through D-11 show the results of the VOC sampling done during this survey. Measured concentrations of bromodichloromethane, bromoform, chloroform, and chlorodibromomethane are commonly found in municipal sewage as disinfection byproducts. The total concentration of these contaminants together never exceeded the SDWA criteria of 100 µg/l.

In general, the VOC concentrations measured during this survey were low and indicate a minor impact of industrial operations on the quality of the wastewater. Sites 1, 3, 5, 7, and 8 showed no VOC concentrations above the criteria shown in Table D-1. No VOC concentrations exceeded the Water Quality Criteria or Industrial Pretreatment Standards.

Concentrations of tetrachloroethylene in excess of the 5 µg/l SDWA criteria were found at Sites 2 (one day), 4 (one day), 6 (2 of 7 days), and at Site 10 (2 of 7 days). Tetrachloroethylene is a common dry cleaning solvent used in the cold cleaning and degreasing of metals (5). Since detectable levels of tetrachloroethylene were found in the equipment blank sample, these concentrations are suspect. Contamination of these samples could have occurred due to contamination of the sampling equipment or as a result of a laboratory artifact.

Carbon tetrachloride concentrations were found to exceed the SDWA criteria of 5 µg/l at Sites 4 (one day) and 9 (one day). Carbon tetrachloride, a common degreasing agent, is used in fire extinguishers, metal finishing, and paint and ink formulations (6). This contaminant was also found in the equipment blank, so again, these results are questionable. Contamination may have actually occurred during sample collection or these results may reflect a laboratory artifact.

Though no xylene concentrations exceeded existing criteria, concentrations found at Sites 3 and 5 ranged from 546-1723 µg/l. Xylene is a component of fuels and is used as a solvent for inks, resins, additives, insecticides, paints, and lacquers (5). Apparently the small concentrations of xylene detected in the discharge from the ANG and AFRES maintenance areas are a result of xylene being washed down the drains. Since no benzene or toluene was detected in these samples, fuels would be ruled out as a source of the xylene.

Metals

Concentrations of metals measured during this survey are shown in Tables E-2 through E-11. Though analysis of samples for hexavalent chromium, Cr(VI), was requested, the samples were not preserved properly and the 24-hour holding time was exceeded. Therefore, no hexavalent chromium results were reported by the laboratory. However, since total chromium represents the sum of the hexavalent and trivalent chromium in a water sample, the total chromium results indicate that chromium is not present in high concentrations in the wastewater.

In general, the metals concentrations in the raw wastewater showed low levels of contamination. When the concentrations of metals measured at the WWTP effluent (Site 10) are compared to the Water Quality Criteria standards, it can be seen that no criteria standards were exceeded.

The levels of metals at the other sites were compared to the Industrial Pretreatment Standards, since these are the most applicable standards to apply to raw, untreated sewage. No levels measured during this survey exceeded the pretreatment standards. However, one high concentration of silver (320 µg/l) was detected at Site 8 on 19 July 1991. This level may have been due to photographic processing at the Audiovisual shop. In addition, a concentration of 1440 µg/l of zinc was found at Site 9 on 23 July 1991.

Other Results

Sample results for various other pollutants measured during this survey are shown in Tables F-1 through F-9. Oils and greases levels, as shown in Table F-1, ranged from 1-244.8 mg/l. The highest concentrations were detected at Sites 1, 2, 6, 7, and 9. In Table F-2, total petroleum hydrocarbon levels are shown. When the total petroleum hydrocarbon concentrations are divided by the oils and greases levels (Table F-1), the resulting fraction represents the percentage of oils and greases from petroleum sources as shown in Table F-3. If these percentages are averaged, the result is 27.7% (standard deviation 24.8%). Therefore, approximately a quarter of the oils and greases found during this survey are from petroleum sources. The remainder of the oils and greases are due to animal and vegetable fats and oils or other sources.

The results of ammonia sampling, shown in Table F-4, show that the concentration of ammonia in the ARF wastewater ranges between 11.5-24.3 mg/l. The WWTP effluent consistently reduced these concentrations to below 3.0 mg/l and appeared to be meeting its monthly discharge limit of 1.5 mg/l. The results of cyanide sampling are shown in Table F-5 and show that the levels of cyanide in the ARF's wastewater are very low. Again the WWTP is adequately treating the cyanide to detectable limits or below.

Phenol, total residue, and phosphorus concentrations were measured at the Lift Station (Site 6) and at the WWTP effluent (Site 10). These results are shown in Tables F-6 through F-8, respectively. The phenol concentrations in the wastewater leaving the ARF ranged from 18-120 µg/l. These levels were adequately treated by the WWTP to the detectable limit of 10 µg/l or below. The total residue measured is typical of domestic sewage, and indicates no problems. Phosphorus concentrations in the ARF wastewater is also typical of domestic sewage. The phosphorus concentrations measured at the WWTP effluent during this survey appeared to be exceeding the 2.0 mg/l monthly average standard set in the NPDES permit.

Analyses were also performed to determine the concentration of Total Toxic Organics (TTOs) in the ARF wastewater and in the WWTP effluent. A TTO, as defined by EPA (7), is the summation of all quantifiable concentrations greater than 0.01 mg/l for 78 organic chemicals. The sum of the quantifiable concentrations must not exceed 2.13 mg/l. The results of the TTO analyses (for other than VOCs) are shown in Table F-9 for the Lift Station and WWTP effluent. These results must be used with the results of the VOC sampling to determine the quantifiable concentration. No concentrations of these chemicals exceeded .01 mg/l. Therefore, the TTO result for both sites is 0 mg/l.

Storm Water Sampling

During the latter part of this survey, the following rainfall was recorded by the Willow Grove NAS Weather Squadron: 0.17 inches (0.4 cm) on 20 July 1991, 0.3 inches (0.8 cm) on 22 July 1991, and 0.41 inches (1 cm) on 23 July 1991. The past meteorological history for Willow Grove NAS shows that for the month of July, 4.64 inches (11.8 cm) of rain falls over an average period of 7.2 days (8). If it is assumed that discrete rain events occur on separate days, the average discrete rain event during July is 0.6 inches (1.6 cm).

Samples of the storm water holding pond were collected on 24 July 1991 at the sluice gate of the pond. These samples were analyzed for the parameters listed in the federal law and the results are shown in Tables G-1 through G-3. At this time, the results in these tables can only be compared to published literature values of storm water quality, since standards have not yet been established by the EPA. Literature values cited by Novotny and Chesters (9) for some pollutants are shown in Table G-3 and indicate that the quality of the pond's storm water falls well within the range of storm water pollutant concentrations. It should also be noted that small amounts of tetrachloroethylene and 1,3-dichlorobenzene were detected in the pond water. As stated before, blank samples have shown detectable levels of tetrachloroethylene; therefore, this contaminant is suspect.

Prior to and during this sampling, it was evident that the rainwater drained from the Bulk Fuel Storage Area is contaminated with fuel and is stressing the vegetation downgradient of the drain (Figure 7). The absorbent pads that were lying in the drainage area below the pipe were not effectively controlling the petroleum hydrocarbons discharged when the diked area is drained.

Oil/Water Separator Sampling

Results of the oil/water separator sampling are shown in Tables H-1 through H-4. Table H-1 shows the results of VOC sampling conducted on the outfall side of separators. These results are incomplete because the analyst encountered problems with foaming during analysis. However, the limited results do show that the water coming out of the separators at Sites 12 and 13 (Figure 8), and the water in the holding tank for the waterfall paint booth do not contain significant amounts of VOCs.

Table H-2 shows the results of oil analysis for hazardous waste characterization. These results show that the oil in the separator at Site 20 had a flashpoint lower than 140°F (60°C), and a PCB concentration of 20 mg/kg (ppm). The oil in this separator is a hazardous waste, and must be disposed of as such.

Table H-3 shows the results of the outfall water sampling for metals at the sites where we could collect discharge samples from the separator. High iron and zinc concentrations were found in the discharges from Sites 12 and 14, indicating that corrosion is causing these metals to leach into the effluent discharge.

Figure 7. Discharge Pipe for Bulk Fuel Storage Area.

Figure 8. Oil/Water Separator, Site 13.

CONCLUSIONS

Low levels of VOCs and total metals contamination indicate that generally good shop practices are being followed at the ARF which prevents indiscriminate dumping of industrial wastes into the sanitary sewer system. However, the detection of significant amounts of xylene from the ANG and AFRES maintenance areas indicates that this solvent may be washing down some drains into the sanitary sewer system.

Storm water runoff drained from the Bulk Fuel Storage Area is impacting the vegetation downgradient of the drain valve.

One total silver concentration of 320 µg/l indicates that the Audiovisual Photo Laboratory is discharging some silver to the WWTP. The small amount, though, is undetectable in the WWTP effluent, indicating silver is being treated adequately.

Approximately one-fourth of the measurable oils and greases in the ARF's wastewater is from petroleum hydrocarbons. All oils and greases are adequately treated by the WWTP.

The WWTP appeared to be meeting its effluent concentration-based permit standard for ammonia. However, the effluent phosphorus concentrations appeared to be exceeding the concentration-based permit limitations.

Storm water sampling indicated that the impact of runoff from the industrial areas of the ARF into the Storm Water Holding Pond was minimal.

The upkeep of some of the oil/water separators was poor. In particular, separators at Sites 12, 13, and 22 were enclosed in concrete vaults that were either half-full or full of standing water. These separators need some immediate attention by Civil Engineering and periodic inspections by the separators' facility managers.

The oil in one separator (Site 20) was found to have hazardous waste characteristics. This oil must be handled and disposed of properly by the contractor.

The oil in the separators at Sites 14-19 and 21 was found to meet the criteria of the contractor and can be used for energy recovery. The contractor should test and dispose of the oil (if any) at Site 13.

RECOMMENDATIONS

A review of the chemical listings for shops upstream of Sites 3 and 5 should be performed to determine potential sources of xylene. Once this source is found, actions should be taken to eliminate the discharge of xylene into the sewer system.

A pollution control system, such as an oil/water separator, should be installed at the Bulk Fuel Storage Area drain valve to contain the petroleum hydrocarbons being discharged during drainage of storm water.

The water standing in the vaults at Sites 12, 13, and 22 should be pumped out. The high total iron in the water indicates that considerable corrosion of the steel separators is occurring.

All oil/water separators should be inspected more frequently by the facility manager. The following excerpt is taken from Aymong (10):

OPERATION AND MAINTENANCE

An oil/water separator cannot be expected to perform well without receiving necessary attention. The number one cause of oil/water separator performance is lack of maintenance.

1. The facility shall be inspected weekly by the owner.

2. The amount of debris such as sand, gravel, dirt, leaves, wood, rags, etc., permitted to enter the separator must be minimized for maximum effectiveness. Catch basins and drains installed ahead of the separator should be inspected and cleaned on a regular basis.

3. Waste oil, such as automobile and truck crank case oil, or engine coolant, such as ethylene glycol, should not be intentionally drained into the separator. Waste oil and engine coolant should be dumped into the appropriate waste slop tanks for proper disposal in accordance with current local government Health Department requirements.

4. Separators should be maintained as free of accumulated oil and sediment as possible. A simple and effective means is required to remove these accumulated deposits. Access for truck pumpers for sludge and oil removal is mandatory.

5. Separator should be cleaned annually, or as needed. The effluent shutoff valve is to be closed during cleaning operations. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at a discharge location approved by the local government. Following removal of any standing water, it shall be replaced with clean water to prevent oil carry-over through the outlet.

6. It is imperative that high alkaline detergents and solvents be excluded from the separator system. The gravity separator will not remove chemical emulsions or dissolved hydrocarbons and their presence retards the recovery of oil that would otherwise be separated. Waste water containing a high dissolved solids concentration, such as untreated sanitary sewage, must be excluded due to its emulsifying tendency.

7. Oils with a specific gravity greater than 0.95 and dissolved hydrocarbons require special treatment.

8. If oil absorbent pads used in the clearwell are to be used in the clearwell, they are to be replaced in the fall, prior to the wet season and in the spring. Used absorbent pillows shall be properly disposed of.

9. The separator system should be kept from freezing at all times. Two of the most available methods to achieve this are as follows:

A. The separator may be located at an elevation so that the top of the liquid is below the frost line.

B. If the frost line is too deep to allow for economical location beneath, insulation and/or the inclusion of heating devices in the separator may be applied.

10. To summarize briefly some of the factors that adversely affect separator performance:

A. Excessive Turbulence.

B. Pumping into the separator.

C. Too high a feed rate.

D. High alkaline detergent or surfactants.

E. Inefficient oil removal.

F. Sludge build-up on the bottom.

G. Freezing.

REFERENCES

1. Federal Register, Vol. 55, No. 222, Friday, November 16, 1990, pages 48062-48091.

2. Code of Federal Regulations, Parts 141-143, July 1, 1991.

3. Water Quality Criteria for Water, 1986, US EPA Office of Water Regulations and Standards, Washington, DC, May 1986.

4. Code of Federal Regulations, Part 403, July 1, 1990.

5. Armstrong Aerospace Medical Research Laboratory. The Installation Restoration Program Toxicology Guide, Vol 2, pages 17-12 (tetrachloroethylene) and 21-24 (xylene). Wright-Patterson AFB, OH: USAF AAMRL 1989.

6. Howard, P. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. II, pages 85-86. Chelsea, MI: Lewis Publishers, Inc., 1990.

7. Code of Federal Regulations, Title 40, Part 413, Section 2(i), July 1, 1990.

8. Worldwide Airfield Climatic Data, Volume VIII, Part 7 (Appalachian Mountains, Middle Atlantic Region and Northeast Region), pages 473-474. USAF Environmental Technical Applications Center (ETAC), Washington, DC, March 1970.

9. Novotny, V. and Chesters, C. Handbook of Nonpoint Pollution, Sources and Management, page 12. New York, NY: Van Norstrand Reinhold Company, 1981.

10. Aymong, G. New EPA Regulations and Oil/Water Separators: How Are They Affecting Industry?. A paper distributed by Highland Tank and Manufacturing Co., Stoystown, PA 1991.

APPENDIX A

REQUEST LETTER

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE RESERVE
ROBINS AIR FORCE BASE, GEORGIA 31098-6001

REPLY TO ATTN OF: SGB

27 Mar 90

SUBJECT: Request for AF OEHL Industrial Wastewater Survey, 913 TAG/SGPB

TO: HQ OEHL/CC

The attached request is forwarded for your action in accordance with AFR 161-17.

PATRICIA A. TOOLEY, MSgt, USAFR
NCOIC, Bioenvironmental Engineering Mgt
DCS, Health Services

2 Atch
1. HQ AFRES/DEPV Ltr, 2 Mar 90
2. 913 TAG/SGPB Ltr, 22 Mar 90

cc: 913 TAG/SGPB

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE RESERVE
ROBINS AIR FORCE BASE, GEORGIA 31098-6001

02 MAR 1990

DEPV

ECAMP Recommendation 4.2.2.5, Industrial Wastewater Survey, Willow Grove ARF PA

913 TAG/DE

1. References:

a. Your letter, 12 Feb 90, same subject

b. AFM 91-32, Operation and Maintenance of Domestic and Industrial Wastewater Systems

2. The primary justification for an industrial wastewater survey is to determine whether or not the wastewater requires pretreatment (Ref 1b, Chap 15). Pretreatment helps prevent treatment plant operational problems and ensures plant compliance with National Pollutant Discharge Elimination System (NPDES) effluent limitations. We agree performing the numerous components of this survey (e.g., sampling, analysis, field survey) by use of a private contractor would require a significant financial expenditure. This significant expenditure can be avoided by requesting HSD (OEHL) to conduct this survey in accordance with AFR 161-17, USAF Occupational and Environmental Health Laboratory (OEHL) Services.

3. We therefore suggest your Base Bioenvironmental Engineer (BEE) request HSD to conduct the industrial wastewater survey as provided in AFR 161-17. Provide AFRES/DEPV with an information copy of the letter of request to HSD.

4. Our points of contact are Jon Atkinson and Tom Russell, AUTOVON 468-5598.

FOR THE COMMANDER

SIGNED

BOBBY G. CLARY
Asst DCS/Engineering & Services

cc: 913 TAG/SGB

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 913TH TACTICAL AIRLIFT GROUP (AFRES)
WILLOW GROVE AIR RESERVE FACILITY, PA 19090-5130

REPLY TO
ATTN OF: SGPB/AV991-1147 22 March 1990

SUBJECT: Request for AF OEHL Industrial Wastewater Survey, per HQ AFRES/DEPV

TO: HQ AFRES/SGB

Please forward the subject request, in order to meet a requirement from the external ECAMP inspection, and as recommended by the 2 March 1990 letter from HQ AFRES/DEPV, attached. Local capabilities are not available.

JONATHAN A. BACH
Industrial Hygienist

Atch: HQ AFRES/DEPV Ltr, 2 MAR 90

cc: HQ AFRES/DEPV
913 CES/DEEV

A GREAT WAY TO SERVE

APPENDIX B

SAMPLING STRATEGY

DEPARTMENT OF THE AIR FORCE
ARMSTRONG LABORATORY (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235-5000

REPLY TO ATTN OF: OEBE (Capt McCoy)

05 JUL 1991

SUBJECT: Willow Grove ARF Wastewater Characterization Survey - Sampling Strategy

TO: 913 TAG/SGPB (Attn: Mr. Bach)

1. A sampling strategy has been developed for the wastewater characterization survey to be performed from 15-26 Jul 91 at Willow Grove ARF. This strategy is shown at Atch 1. Attachment 2 lists the contaminants detected in the screening tests listed in Atch 1. Attachment 3 shows the site locations referenced in the sampling strategy. Our planned itinerary during the survey is at Atch 4.

2. Stormwater runoff sampling will also be performed during this survey. The sampling will be IAW 40 CFR 122, Subpart B. A copy of this law is at Atch 5.

3. As discussed during the presurvey, the successful completion of this survey will require support from your office. The following resources will be required:

a. Two government pickup trucks. Six passenger vehicles are preferred, but three passenger trucks are acceptable.

b. Two refrigerators dedicated to the storage of wastewater samples. These refrigerators should be set up in the Plumbing Shop. If this is not possible, they should be in areas where we will have access to them (including access on the weekend).

c. Access to ice. During past surveys of this size, we have used 3 coolers (30 gallons) of ice per day. Normally a Dining Hall or other eating establishment on base will have a large ice machine to accomodate us. Again access on the weekdays and weekends should be coordinated for us.

d. Keys to the Plumbing Shop and to the Lift Station.

e. Fund cites for the shipment of samples on 22 and 25 Jul 91. We estimate each shipment will be approximately 4 coolers. Because of the holding times of some of the samples, these coolers must be shipped overnight express.

f. Billeting Reservations: The following information is provided to assist you in making billeting arrangements:

Name	Rank	SSAN
Richard P. McCoy	Capt	[redacted]
Mary K. Fields	TSgt	
Robert P. Davis	SSgt	

We request billeting be arranged so that all members of the team will be together for team integrity.

4. Please review this sampling strategy and provide me with comments by 12 Jul 91. Also, please inform me of any difficulties in gathering the requirements listed in the previous paragraph as soon as possible in order for us to work around them. If you should have any questions, please contact me at DSN 240-3305.

Richard P. McCoy

RICHARD P. McCOY, Capt, USAF, BSC
Chief, Water Quality Function

5 Atchs
1. Sampling Strategy
2. Screening Test Analytes
3. Sampling Site Location Map
4. Survey Itinerary
5. Stormwater Runoff Law

cc: HQ AFRES/SGPB (w/o Atch 5)
HQ ANGSC/SGPB (w/o Atch 5)
111 TAC Clinic/SGPB
(w/o Atch 5)

WILLOW GROVE ARF WASTEWATER CHARACTERIZATION SURVEY
Sampling Strategy

Site #	Manhole #	# of Days	Site Description	Analyses
1	21	3	Bldg 340, ANG Phase Dock Bldg 330, ANG Phase Dock/Gun Shop	O&G, TPH, VOA, VOH, Metals
2	West Corner of Bldg 320	3	Bldg 320, ANG NDI, Corrosion Control, Fuel Systems, Dental X-Ray	O&G, TPH, VOA, VOH, Metals, CN, NH3
3	18	3	Bldg 201, AFRES Maint. Hangar	O&G, TPH, VOA, VOH, Metals, CN, NH3
4	12	3	Bldg 201, AFRES Maint. Hangar	O&G, TPH, VOA, VOH, Metals, CN, NH3
5	25	3	Bldg 350, ANG Veh. Maint. Bldg 230, AFRES Non-Powered AGE, Fuel Systems Bldg 232, CE Shops Fire Dept.	O&G, TPH, VOA, VOH, Metals
6	9	7	Lift Station	O&G, TPH, VOA, VOH, Metals, Phenol, CN, NH3, PO4, TSS, TTO (1)
7	6	3	Bldg 353, ANG Vehicle Maint.	O&G, TPH, VOA, VOH, Metals
8	5	3	Bldg 237, AFRES Vehicle Maint. Bldg 238, AFRES Refuel. Maint. Bldg 354, 270th Wire Maint. Bldg 243, Pavements & Grounds	O&G, TPH, VOA, VOH, Metals

WILLOW GROVE ARF WASTEWATER CHARACTERIZATION SURVEY
Sampling Strategy

Site 3	Manhole #	# of Days	Site Description	Analyses
9	3	3	Bldg 234, AFRES Life Support Bldg 300, ANG HQ Bldg 216, Airbase Operability Bldg 204, Photo Lab Bldg 203, AFRES HQ	O&G, TPH, VOA, VOH, Metals, CN, NH3
10	Final Eff.	7	WWTP Effluent	O&G, TPH, VOA, VOH, Metals, CN, NH3, PO4, TSS, Phenol, TTO(1)

LIST OF CONTAMINANTS MEASURED IN SCREENING TESTS

Screening Test	Contaminants Analyzed
Metals	Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium (total), Chromium (VI), Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Zinc
VOHs	Bromodichloromethane, Bromoform, Bromomethane, Carbon Tetrachloride, Chlorobenzene, Chloroethane, 2-Chloroethylvinyl Chloroform, Chloromethane, Dibromochloromethane, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, dichlorodifluoromethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, 1,2-dichloropropane, cis-1,3-dichloropropene, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, trichlorofluoromethane, vinyl chloride
VOAs	Benzene, Chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, ethylbenzene, toluene
TTO	Chloromethane, bromomethane, vinyl chloride, chloroethane, dichloromethane, trichlorofluoromethane, 1,1-dichloroethane, 1,1-dichloroethylene, total-1,2-dichloroethylene, chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane, carbon tetrachloride, bromodichloromethane, 1,2-dichloropropane, trans-1,3-dichloropropylene, trichloroethylene, benzene, chlorodibromomethane, 1,1,2-trichloroethane, cis-1,3-dichloropropylene, 2-chloroethylvinyl ether, bromoform, 1,1,2,2-tetrachloroethane, tetrachloroethane, toluene, chlorobenzene, ethyl benzene, 1,3-dichlorobenzene, 1,2 & 1,4-dichlorobenzenes, Aldrin, alpha-BHC, beta-BHC, delta-BNHC, gamma-BHC, Chlordane, DDD, DDE, p,p-DDT, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin aldehyde, Heptachlor, Heptachlor epoxide, Toxaphene, Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260

Atch 2

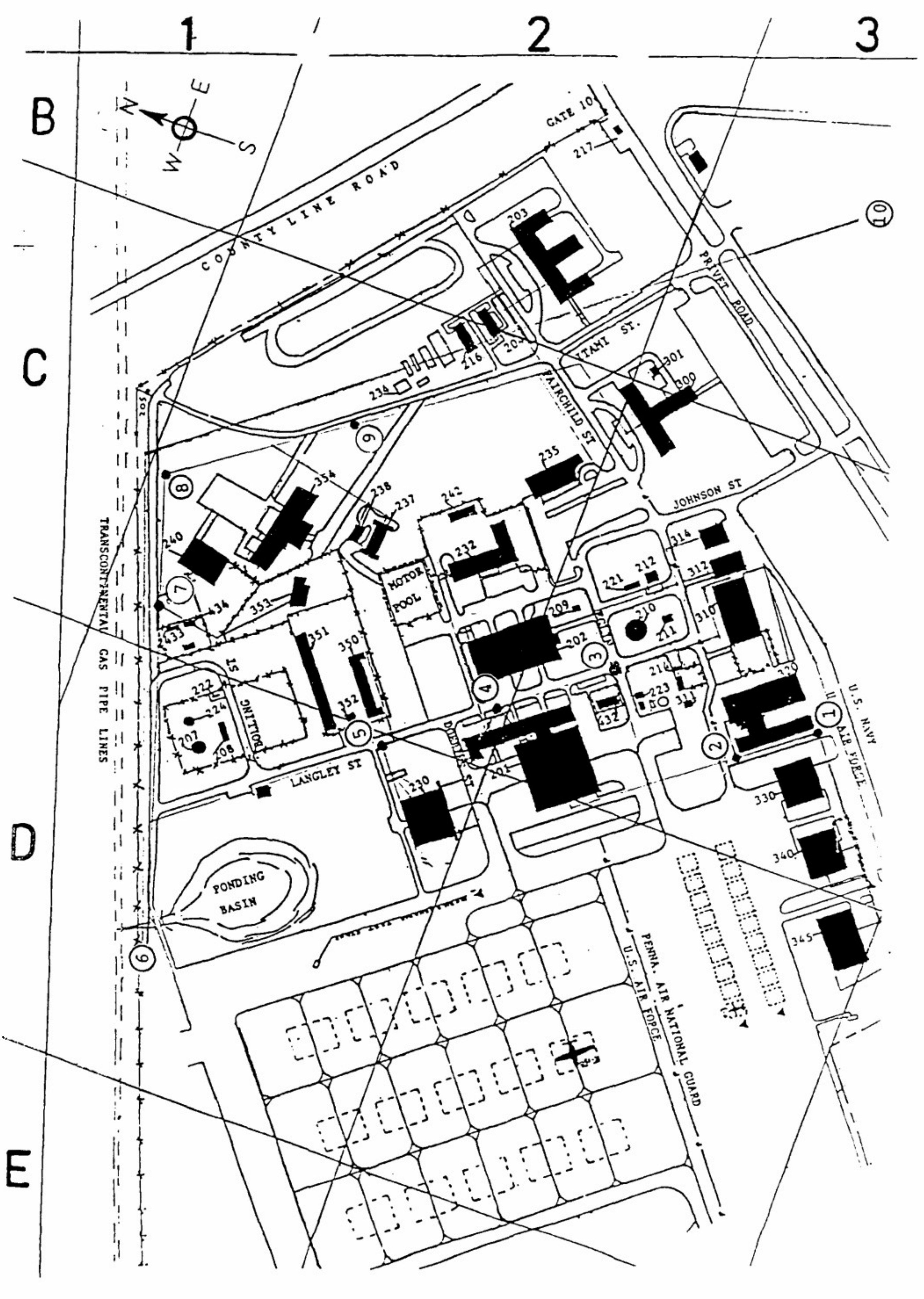

Figure B-1. Locations of the Wastewater Sampling Sites.

ITINERARY FOR WASTEWATER CHARACTERIZATION SURVEY

15 Jul	Arrive Philadelphia Airport @ 1700 Check into Billeting
16 Jul	Unpack equipment, prepare samplers
17 Jul	Deploy samplers at Sites 1,3,5,6,8,10
18-21 Jul	Collect samples
21 Jul	Pick up samplers @ Sites 1,3,5,8 (Samplers at Sites 6 and 10 remain in place.)
22 Jul	Deploy samplers at Sites 2,4,7,9. Ship first set of samples to Brooks
23-25 Jul	Collect samples
25 Jul	Collect samplers at all sites, pack equipment for shipment by TMO, and ship samples to Brooks
26 Jul	Depart via Philadelphia Airport 0949

Atch 4

APPENDIX C

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLING RESULTS

TABLE C-1, Results of Equipment Blank Analysis for Volatile Organic Chemicals
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):	Equipment Blank
Bromodichloromethane	<0.4
Bromoform	<0.7
Carbon Tetrachloride	0.62
Chlorobenzene	<0.6
Chloroethane	<0.9
Chloroform	<0.3
Chloromethane	<0.8
Chlorodibromomethane	<0.5
1,2-Dichlorobenzene	<1.0
1,3-Dichlorobenzene	<0.5
1,4-Dichlorobenzene	<0.7
Dichlorodifluoromethane	<0.9
1,1-Dichloroethane	<0.4
1,2-Dichloroethane	<0.3
1,1-Dichloroethene	<0.3
Trans-1,2-Dichloroethene	<0.5
1,2-Dichloropropane	<0.3
Cis-1,3-Dichloropropene	<0.5
Trans-1,3-Dichloropropene	<0.5
Methylene Chloride	<0.4
1,1,2,2-Tetrachloroethane	<0.5
Tetrachloroethylene	2.6
1,1,1-Trichloroethane	<0.5
1,1,2-Trichloroethane	<0.5
Trichloroethylene	<0.5
Trichlorofluoromethane	<0.4
Vinyl Chloride	<0.9
2-Chloroethylvinyl Ether	<0.9
Bromomethane	<0.9
Volatile Organic Aromatics (EPA Method 602):	
1,3-Dichlorobenzene	<0.5
1,4-Dichlorobenzene	<0.7
Ethyl Benzene	<0.3
Chlorobenzene	<0.6
Toluene	<0.3
Benzene	<0.5
1,2-Dichlorobenzene	<1.0

TABLE C-2, Results of Equipment and Reagent Blank Analyses For Metals WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991			
ANALYTE	UNITS:	Equipment Blank	Reagent Blank
Antimony	ug/l	<10	<10
Arsenic	ug/l	<10	<10
Barium	ug/l	<100	<100
Beryllium	ug/l	<10	<10
Boron	ug/l	<200	
Cadmium	ug/l	<10	<10
Calcium	mg/l	<0.1	0.3
Chromium	ug/l	<50	<50
Chromium VI	ug/l	HTE	HTE
Copper	ug/l	<20	<20
Iron	ug/l	<100	<100
Lead	ug/l	<20	<20
Magnesium	mg/l	<0.1	0.3
Manganese	ug/l	<50	<50
Mercury	ug/l	<1	<1
Nickel	ug/l	<50	<50
Potassium	mg/l	<0.1	0.2
Selenium	ug/l	<10	<10
Silver	ug/l	<10	<10
Sodium	mg/l	187	1.1
Thallium	ug/l	<10	<10
Zinc	ug/l	<50	<50

HTE = Holding Time Exceeded

TABLE C-3, Results of Equipment and Reagent Blank Analyses For Other Results WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991			
ANALYTE	UNITS:	Equipment Blank	Reagent Blank
Oil & Grease	mg/l	0.3	
Total Hydrocarbons	mg/l	<1.0	
Ammonia	mg/l		<0.2
Cyanide (Total)	mg/l		<0.005

APPENDIX D

VOLATILE ORGANIC CHEMICAL RESULTS

TABLE D-1, Standards for Volatile Organic Chemicals WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991 (All Concentrations in ug/l)			
Volatile Organic Hydrocarbons (EPA Method 601):			
	Water Quality Standard	SDWA Standard	Pretreatment Standard*
Bromodichloromethane		100	
Bromoform		100	
Carbon Tetrachloride	35,200	5	142
Chlorobenzene	250	100	142
Chloroethane			110
Chloroform		100	
Chloromethane	11,000		
Chlorodidromomethane		100	
1,2-Dichlorobenzene	763	600	196
1,3-Dichlorobenzene	1120	600	142
1,4-Dichlorobenzene	1120	75	142
Dichlorodifluoromethane			
1,1-Dichloroethane			22
1,2-Dichloroethane	20	5	180
1,1-Dichloroethene	11,600	7	22
Trans-1,2-Dichloroethene	11,600	100	25
1,2-Dichloropropane	5700	5	196
Cis-1,3-Dichloropropene	244		196
Trans-1,3-Dichloropropene	244		196
Methylene Chloride	11,000		36
1,1,2,2-Tetrachloroethane	2400		
Tetrachloroethylene	840	5	52
1,1,1-Trichloroethane	18,000	200	22
1,1,2-Trichloroethane	2400		32
Trichloroethylene	21,900	5	26
Trichlorofluoromethane	11,000		
Vinyl Chloride		2	97
2-Chloroethylvinyl Ether			
Bromomethane	11,000		
Volatile Organic Aromatics (EPA Method 602):			
1,3-Dichlorobenzene	1120	600	142
1,4-Dichlorobenzene	1120	600	142
Ethyl Benzene	32,000	700	142
Chlorobenzene	250	100	142
Toluene	17,500	1000	28
Benzene	700	5	57
1,2-Dichlorobenzene	763	600	196
Xylene		10,000	

* Based on Pretreatment Standards for Organic Chemical Manufacturing

TABLE D-2, Results of Volatile Organic Analyses for
Site 1, Bldgs 330, 340: ANG Phase Docks
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):				Duplicate
	18 Jul	19 Jul	20 Jul	20 Jul
Bromodichloromethane	<0.4	<0.4	<0.4	<0.4
Bromoform	3.1	<0.7	<0.7	<0.7
Carbon Tetrachloride	1.1	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	3.2	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6	<0.6
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):				
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Ethyl Benzene	<0.3	<0.3	<0.3	<0.3
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Toluene	14.7	<0.3	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0

TABLE D-3, Results of Volatile Organic Analyses for Site 2, Bldg 320: ANG NDI, Corrosion Control WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991 (All Concentrations in ug/l)			
Volatile Organic Hydrocarbons (EPA Method 601):			
	23 Jul	24 Jul	25 Jul
Bromodichloromethane	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7
Carbon Tetrachloride	0.9	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5
Tetrachloroethylene	5.1	3.7	2
1,1,1-Trichloroethane	3.4	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethylene	1	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):			
1,3-Dichlorobenzene		0.8	0.5
1,4-Dichlorobenzene		<0.7	<0.7
Ethyl Benzene	1.7	1.5	<0.3
Chlorobenzene	1	<0.6	<0.6
Toluene	<0.3	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5
1,2-Dichlorobenzene		0.6	<1.0

TABLE D-4, Results of Volatile Organic Analyses for
Site 3, Bldg 201: AFRES Maintenance Hangar
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):				Duplicate
	18 Jul	19 Jul	20 Jul	20 Jul
Bromodichloromethane	<0.4	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	0.7	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6	<0.6
1,1,1-Trichloroethane	8.7	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):				
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Ethyl Benzene	<0.3	<0.3	<0.3	<0.3
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Toluene	4.1	<0.3	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0
p-Xylene		547		
o-Xylene		546		

TABLE D-5, Results of Volatile Organic Analyses for Site 4, Bldg 201: AFRES Maintenance Hangar WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991 (All Concentrations In ug/l)			
Volatile Organic Hydrocarbons (EPA Method 601):			
	23 Jul	24 Jul	25 Jul
Bromodichloromethane	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7
Carbon Tetrachloride	0.8	<0.5	32
Chlorobenzene	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	7
1,3-Dichlorobenzene	<0.5	<0.5	10
1,4-Dichlorobenzene	<0.7	<0.7	11
Dichlorodifluoromethane	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5
Tetrachloroethylene	4.9	3.6	50
1,1,1-Trichloroethane	<0.5	<0.5	12
1,1,2-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethylene	0.9	<0.5	21
Trichlorofluoromethane	<0.4	0.6	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):			
1,3-Dichlorobenzene	3.9	1.1	10
1,4-Dichlorobenzene	<0.7	1.8	10
Ethyl Benzene	2.4	1.5	23
Chlorobenzene	<0.6	<0.6	12
Toluene	0.5	<0.3	5.2
Benzene	<0.5	<0.5	3.2
1,2-Dichlorobenzene	<1.0	1.5	8.6

TABLE D-6, Results of Volatile Organic Analyses for
Site 5, Bldgs 230, 232, 350
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):			
	18 Jul	19 Jul	20 Jul
Bromodichloromethane	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	0.8	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6
1,1,1-Trichloroethane	6.7	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):			
1,3-Dichlorobenzene		<0.5	<0.5
1,4-Dichlorobenzene		<0.7	<0.7
Ethyl Benzene	<0.3	613	<0.3
Chlorobenzene	<0.6	<0.6	<0.6
Toluene	2.8	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5
1,2-Dichlorobenzene		<1.0	<1.0
p-Xylene		1723	11
o-Xylene		776	4.6

TABLE D-7, Results of Volatile Organic Analyses for
Site 6, Lift Station
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
Bromodichloromethane	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	1	2	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6	<0.6	5.9	6	2.2
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5	<0.5	1.2	1.8	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatic (EPA Method 602):							
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	1.8	2.4	0.5
1,4- Dichlorobenzene	<0.7	<0.7	<0.7	<0.7	2.1	2.1	<0.7
Ethyl Benzene	<0.3	<0.3	<0.3	<0.3	1.9	4.4	<0.3
Chlorobenzene	<0.6	<0.6	<0.6	<0.6	1.1	<0.6	<0.6
Toluene	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	1	2.3	<1.0

TABLE D-8, Results of Volatile Organic Analyses for Site 7, Bldg 353: ANG Vehicle Maintenance WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991 (All Concentrations in ug/l)				
Volatile Organic Hydrocarbons (EPA Method 601):			Duplicate	
	23 Jul	24 Jul	24 Jul	25 Jul
Bromodichloromethane	<0.4	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	4.2	3.4	2.8	3.6
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	0.6	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):				
1,3-Dichlorobenzene	2.7	3	0.6	0.9
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	0.8
Ethyl Benzene	<0.3	0.8	0.7	<0.3
Chlorobenzene	0.8	<0.6	<0.6	<0.6
Toluene	<0.3	<0.3	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0

TABLE D-9, Results of Volatile Organic Analyses for Site 8, Bldgs 237, 238, 243, 354 WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991 (All Concentrations in ug/l)			
Volatile Organic Hydrocarbons (EPA Method 601):			
	18 Jul	19 Jul	20 Jul
Bromodichloromethane	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8
Chlorodidromomethane	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6
1,1,1-Trichloroethane	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):			
1,3-Dichlorobenzene	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7
Ethyl Benzene	<0.3	<0.3	<0.3
Chlorobenzene	<0.6	<0.6	<0.6
Toluene	0.4	<0.3	<0.3
Benzene	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0
p-Xylene		3.8	
o-Xylene		2.1	

TABLE D-10, Results of Volatile Organic Analyses for
Site 9, Bldgs 203, 204, 216, 234, 300
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):			Duplicate	
	23 Jul	24 Jul	24 Jul	25 Jul
Bromodichloromethane	<0.4	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7	<0.7
Carbon Tetrachloride	9.4	<0.5	<0.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9
Chloroform	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	3.9	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	4.6	<0.5	<0.5	<0.5
1,2-Dichloropropane	1	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	4.9	2.1	3.8	1.7
1,1,1-Trichloroethane	8.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	4.6	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):				
1,3-Dichlorobenzene	3.6	0.6	0.5	0.5
1,4-Dichlorobenzene	3.1	<0.7	<0.7	<0.7
Ethyl Benzene	7.3	<0.3	<0.3	<0.3
Chlorobenzene	5.8	<0.6	<0.6	<0.6
Toluene	3.2	<0.3	<0.3	<0.3
Benzene	3.2	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	3.3	<1.0	<1.0	<1.0

TABLE D-11, Results of Volatile Organic Analyses for
Site 10, Wastewater Treatment Plant Effluent
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method 601):							
	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
Bromodichloromethane	1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Bromoform	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	1.5	1.5	<0.5
Chlorobenzene	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Chloroethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Chloroform	2.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chloromethane	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Dichlorodifluoromethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
1,1-Dichloroethane	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
1,2-Dichloroethane	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.6	<0.6	<0.6	<0.6	6	5.2	1.9
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	0.8	1.3	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethylene	<0.5	<0.5	<0.5	<0.5	1.5	1.4	<0.5
Trichlorofluoromethane	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Vinyl Chloride	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
2-Chloroethylvinyl Ether	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Bromomethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Volatile Organic Aromatics (EPA Method 602):							
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	1.4	1.2	<0.5
1,4-Dichlorobenzene	<0.7	<0.7	<0.7	<0.7	1.7	1.6	<0.7
Ethyl Benzene	<0.3	<0.3	<0.3	<0.3	<0.3	1.3	<0.3
Chlorobenzene	<0.6	<0.6	<0.6	<0.6	0.9	<0.6	<0.6
Toluene	0.3	<0.3	<0.3	<0.3	0.5	<0.3	<0.3
Benzene	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

APPENDIX E

METALS RESULTS

TABLE E-1, Standards for Metals WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991				
ANALYTE	UNITS:	Water Quality Criteria	SDWA Standards	Pretreatment Standards
Antimony	ug/l	1600		
Arsenic	ug/l		50	
Barlum	ug/l		1000	
Beryllium	ug/l	5.3		
Boron	ug/l			
Cadmium	ug/l	1.1	5	70
Calcium	mg/l			
Chromium	ug/l	210	100	1710
Chromium VI	ug/l	11	100	
Copper	ug/l	12	1300	2070
Iron	ug/l	1000	300	
Lead	ug/l	3.2	15	400
Magnesium	mg/l			
Manganese	ug/l		50	
Mercury	ug/l	0.012	2	
Nickel	ug/l	160	100	2380
Potassium	mg/l			
Selenium	ug/l	35	50	
Silver	ug/l	0.12	50	240
Sodlum	mg/l			
Thallium	ug/l	40	1	
Zlnc	ug/l	110	5000	1480

TABLE E-2, Results of Metals Analyses for
Site 1, Bldgs 330, 340: ANG Phase Docks
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	17 Jul	18 Jul	19 Jul	Duplicate 19 Jul
Antimony	ug/l	<10	14	70.8	
Arsenic	ug/l	<10	<10	<10	57.3
Barium	ug/l	219	235	208	<200
Beryllium	ug/l	<10	<10	<10	<10
Boron	ug/l	5200	5900	2600	2600
Cadmium	ug/l	<10	<10	<10	11
Calcium	mg/l	41.1	44.9	36.7	36.5
Chromium	ug/l	<50	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE	HTE
Copper	ug/l	49.1	69	68	86
Iron	ug/l	4010	1580	2400	3180
Lead	ug/l	39.5	<20	24	30
Magnesium	mg/l	20.9	22.6	18.4	18.1
Manganese	ug/l	195	65	79	107
Mercury	ug/l	<1	<1	<1	<1
Nickel	ug/l	<50	<50	<50	<50
Potassium	mg/l	18.7	26.4	17.5	17
Selenium	ug/l	<10	<10	<10	<10
Silver	ug/l	<10	<10	<10	<10
Sodium	mg/l	33.2	44.4	30.6	36
Thallium	ug/l	<10	<10	<10	<10
Zinc	ug/l	180	176	222	272

HTE = Holding Time Exceeded

TABLE E-3, Results of Metals Analyses for
Site 2, Bldg 320: ANG NDI, Corrosion Control
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	22 Jul	23 Jul	24 Jul
Antimony	ug/l	<10	16	<10
Arsenic	ug/l	<10	<10	<10
Barium	ug/l	250	3010	218
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	5300	4500	2000
Cadmium	ug/l	<10	28	<10
Calcium	mg/l	51.7	46.6	48.6
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	75	144	65
Iron	ug/l	1120	2330	848
Lead	ug/l	<20	56	21
Magnesium	mg/l	21.1	17.6	23.4
Manganese	ug/l	55	83	58
Mercury	ug/l	<1	<1	<1
Nickel	ug/l	<50	<50	<50
Potassium	mg/l	28.2	15.4	3505
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	<10	<10
Sodium	mg/l	55.6	44.6	52
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	195	278	197

HTE = Holding Time Exceeded

TABLE E-4, Results of Metals Analyses for
Site 3, Bldg 201: A[illegible]RES Maintenance Hangar
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	17 Jul	[illegible]l	19 Jul	Duplicate 19 Jul
Antimony	ug/l		<10		101
Arsenic	ug/l	<10	<10	<10	<10
Barium	ug/l	242	242	264	274
Beryllium	ug/l	<10	<10	<10	<10
Boron	ug/l	1250	700	900	1900
Cadmium	ug/l	<10	<10	<10	<10
Calcium	mg/l	50.8	47.5	48.3	49
Chromium	ug/l	<50	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE	HTE
Copper	ug/l	<20	<20	27.3	44
Iron	ug/l	263	114	165	392
Lead	ug/l	<20	<20	<20	<20
Magnesium	mg/l	23.1	22.4	22.7	23.1
Manganese	ug/l	<50	<50	<50	<50
Mercury	ug/l	<1	<1	<1	<1
Nickel	ug/l	<50	<50	<50	<50
Potassium	mg/l	8.7	7	10	10.6
Selenium	ug/l	<10	<10	<10	<10
Silver	ug/l	<10	<10	<10	<10
Sodium	mg/l	38.4	18.1	22.8	23.6
Thallium	ug/l	<10	<10	<10	<10
Zinc	ug/l	78	88	147	182

HTE = Holding Time Exceeded

TABLE E-5, Results of Metals Analyses for
Site 4, Bldg 201: AFRES Maintenance Hangar
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	22 Jul	23 Jul	24 Jul
Antimony	ug/l	<10	<10	<10
Arsenic	ug/l	<10	<10	<10
Barium	ug/l	223	214	230
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	1200	2000	1350
Cadmium	ug/l	<10	<10	<10
Calcium	mg/l	46.4	38.9	47.2
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	26	49	22
Iron	ug/l	<100	1880	230
Lead	ug/l	<20	77	<20
Magnesium	mg/l	19.8	15.1	20.3
Manganese	ug/l	<50	<50	<50
Mercury	ug/l	<1	<1	3.4
Nickel	ug/l	<50	<50	<50
Potassium	mg/l	10.9	10.8	10.5
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	<10	<10
Sodium	mg/l	44.1	28	22.4
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	81	199	<50

HTE = Holding Time Exceeded

TABLE E-6, Results of Metals Analyses for
Site 5, Bldgs 230, 232, 350
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	17 Jul	18 Jul	19 Jul
Antimony	ug/l	<10	<10	<10
Arsenic	ug/l	<10	<10	<10
Barlum	ug/l	224	279	237
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	2750	1250	1100
Cadmium	ug/l	<10	<10	<10
Calcium	mg/l	48.3	48.9	46.3
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	23.4	102	24
Iron	ug/l	138	971	<100
Lead	ug/l	<20	41	<20
Magnesium	mg/l	21.8	21.2	20.8
Manganese	ug/l	<50	<50	<50
Mercury	ug/l	<1	<1	<1
Nickel	ug/l	<50	<50	<50
Potasslum	mg/l	9.7	11.2	11.4
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	<10	<10
Sodium	mg/l	27.6	23.2	24.2
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	73	776	69

HTE = Holding Time Exceeded

TABLE E-7, Results of Metals Analyses for Site 6, Lift Station WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991								
ANALYTE	UNITS:	17 Jul	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul
Antimony	ug/l		<10		<10	<10	<10	<10
Arsenic	ug/l	<10	<10	<10	<10	<10	<10	<10
Barium	ug/l	722	203	295	786	391	252	379
Beryllium	ug/l	<10	<10	<10	<10	<10	<10	<10
Boron	ug/l	1650	2300	1250	900	1100	950	1400
Cadmium	ug/l	<10	<10	<10	16	<10	<10	<10
Calcium	mg/l	53.3	47.4	46.4	63.6	52.2	44	40.7
Chromium	ug/l	<50	<50	<50	<50	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE	HTE	HTE	HTE	HTE
Copper	ug/l	144	42	49	211	92	83	273
Iron	ug/l	3700	375	517	5000	1520	1650	2020
Lead	ug/l	24	<20	<20	39	28	<20	<20
Magnesium	mg/l	23.8	22.9	21.6	26.2	23.6	16.6	24.3
Manganese	ug/l	76	<50	<50	115	58	54	57
Mercury	ug/l	<1	<1	<1	<1	<1	<1	<1
Nickel	ug/l	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/l	19.5	21.6	14.9	22.3	27.5	12.8	2.7
Selenium	ug/l	<10	<10	<10	<10	<10	<10	<10
Silver	ug/l	<10	<10	<10	45	<10	<10	<10
Sodium	mg/l	32.2	36.6	30.4	35.3	33.2	53.3	572
Thallium	ug/l	<10	<10	<10	<10	<10	<10	<10
Zinc	ug/l	386	547	120	674	616	191	277

HTE = Holding Time Exceeded

TABLE E-8, Results of Metals Analyses for
Site 7, Bldg 353: ANG Vehicle Maintenance
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	22 Jul	23 Jul	24 Jul
Antimony	ug/l	<10	<10	<10
Arsenic	ug/l	<10	<10	<10
Barium	ug/l	189	378	190
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	1250	1300	1200
Cadmium	ug/l	<10	<10	<10
Calcium	mg/l	49.7	61.8	48.7
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	38	117	53
Iron	ug/l	411	3880	495
Lead	ug/l	<20	<20	<20
Magnesium	mg/l	25	26.4	23.6
Manganese	ug/l	<50	89	56
Mercury	ug/l	<1	<1	<1
Nickel	ug/l	<50	<50	<50
Potassium	mg/l	32.3	18.7	97.6
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	17	15
Sodium	mg/l	45.2	32.4	67.4
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	83	479	145

HTE = Holding Time Exceeded

TABLE E-9, Results of Metals Analyses for
Site 8, Bldgs 237, 238, 243, 354
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	17 Jul	18 Jul	19 Jul
Antimony	ug/l	<10	<10	<10
Arsenic	ug/l	<10	<10	<10
Barium	ug/l	792	284	428
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	500	900	1300
Cadmium	ug/l	<10	<10	<10
Calcium	mg/l	47.4	47.2	48.5
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	84	62	82
Iron	ug/l	1870	275	818
Lead	ug/l	<20	<20	<20
Magnesium	mg/l	25.7	24.9	24.6
Manganese	ug/l	62	<50	57
Mercury	ug/l	<1	<1	<1
Nickel	ug/l	<50	<50	<50
Potassium	mg/l	26.8	18.7	39.6
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	<10	320
Sodium	mg/l	41.6	26.7	69.6
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	200	150	216

HTE = Holding Time Exceeded

TABLE E-10, Results of Metals Analyses for
Site 9, Bldgs 203, 204, 216, 234, 300
WILLOW GROVE ARF WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	22 Jul	23 Jul	24 Jul
Antimony	ug/l	<10	<10	<10
Arsenic	ug/l	<10	<10	<10
Barium	ug/l	233	958	459
Beryllium	ug/l	<10	<10	<10
Boron	ug/l	350	2500	1900
Cadmium	ug/l	<10	<10	<10
Calcium	mg/l	49.9	92.9	65.8
Chromium	ug/l	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE
Copper	ug/l	58	293	123
Iron	ug/l	817	6380	1690
Lead	ug/l	<5.0	<20	<20
Magnesium	mg/l	25.2	34.8	28.5
Manganese	ug/l	<50	444	127
Mercury	ug/l	<1	<1	<1
Nickel	ug/l	<50	<50	<50
Potassium	mg/l	36.4	50.1	94.3
Selenium	ug/l	<10	<10	<10
Silver	ug/l	<10	55	59
Sodium	mg/l	46.4	90.5	70.8
Thallium	ug/l	<10	<10	<10
Zinc	ug/l	238	1440	476

HTE = Holding Time Exceeded

TABLE E-11, Results of Metals Analyses for Site 10, Wastewater Treatment Plant Effluent WILLOW GROVE ARF WASTEWATER SURVEY 15 - 26 JULY 1991								
ANALYTE	UNITS:	17 Jul	18 Jul	19 Jul	20 Jul	22 Jul	23 Jul	24 Jul
Antimony	ug/l		<10	<10	<10	<10	<10	<10
Arsenic	ug/l	<10	<10	<10	<10	<10	<10	<10
Barium	ug/l	185	195	203	201	205	192	189
Beryllium	ug/l	<10	<10	<10	<10	<10	<10	<10
Boron	ug/l	2900	3950	2750	3000	2700	2100	1900
Cadmium	ug/l	<10	<10	<10	<10	<10	<10	<10
Calcium	mg/l	44.3	43.8	44	43.6	46.5	45.7	43.8
Chromium	ug/l	<50	<50	<50	<50	<50	<50	<50
Chromium VI	ug/l	HTE	HTE	HTE	HTE	HTE	HTE	HTE
Copper	ug/l	<20	<20	<20	<20	<20	<20	<20
Iron	ug/l	<100	<100	<100	<100	<100	<100	<100
Lead	ug/l	<5.0	<20	<20	<5.0	<20	<20	<20
Magnesium	mg/l	23	23.3	23.3	23.2	23.7	23.1	22.3
Manganese	ug/l	<50	<50	<50	<50	<50	<50	<50
Mercury	ug/l	<1	<1	<1	<1	<1	<1	<1
Nickel	ug/l	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/l	6	6.5	6.5	13.3	9	8.1	7.7
Selenium	ug/l	<10	<10	<10	<10	<10	<10	<10
Silver	ug/l	<10	<10	<10	<10	<10	<10	<10
Sodium	mg/l	45.9	46.4	45.3	41.2	43.7	43.6	45.3
Thallium	ug/l	<10	<10	<10	<10	<10	<10	<10
Zinc	ug/l	80	73	70	71	<50	<50	<50

HTE = Holding Time Exceeded

APPENDIX F

OTHER SAMPLING RESULTS

TABLE F-1, Results of Oils and Greases Analyses WILLOW GROVE ARF WASTEWATER SURVEY 15-26 July 1991 (All Concentrations In mg/l)									
SITE	18 Jul	19 Jul	20 Jul	Dup 20 Jul	21 Jul	23 Jul	24 Jul	Dup 24 Jul	25 Jul
1	70.8	51.6	145	27.2					
2						30.4	48		86.4
3	21.8	27.2	55.2	22.8					
4						67.2	2.2		2.4
5	48	48.4	55.2						
6	49.6	72	124		106	20	44		6.4
7						21.2	44.8	35.2	244.8
8	32	27.2	24						
9						21.2	139.2	58.4	96
10	2.2	2.4	1.9		1.9	1.5	1		0.9

TABLE F-2, Results of Total Petroleum Hydrocarbons Analyses WILLOW GROVE ARF WASTEWATER SURVEY 15-26 July 1991 (All Concentrations In mg/l)									
SITE	18 Jul	19 Jul	20 Jul	Dup 20 Jul	21 Jul	23 Jul	24 Jul	Dup 24 Jul	25 Jul
1	33.6	14.8	8	3.2					
2						1.6	3.2		19.2
3	7.4	20	1.6	8					
4						6.4	<1.0		<1.0
5	16.8	14.8	4.8						
6	9.6	24	9.6		6.4	1.6	12		1.3
7						<1.0	3.2	3.2	<1.0
8	7.4	3.2	9.6						
9						5	14.4	3.2	<1.0
10	<1.0	<1.0	<1.0		<1.0	<1.0	<1.0		<1.0

TABLE F-3, Percentage of Oils and Greases from Petroleum Sources
WILLOW GROVE ARF WASTEWATER SURVEY
15-26 July 1991
(All Values In Percent [%])

SITE	18 Jul	19 Jul	20 Jul	Dup 20 Jul	21 Jul	23 Jul	24 Jul	Dup 24 Jul	25 Jul
1	47.5	28.7	5.5	11.8					
2						5.3	6.7		22.2
3	33.9	73.5	2.9	35.1					
4						9.5	<45.4		<41.7
5	35.0	30.6	8.7						
6	19.4	33.3	7.7		6.0	8.0	27.3		20.3
7						<4.7	7.1	9.1	<1
8	23.1	11.8	40.0						
9						23.6	10.3	5.5	<1
10	<45.4	<41.7	<52.6		<52.6	<66.7	<100		<100

TABLE F-4, Results of Ammonia Analyses
WILLOW GROVE ARF WASTEWATER SURVEY
15-26 July 1991
(All Concentrations In mg/l)

SITE	18 Jul	19 Jul	20 Jul	Dup 20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
2						24.1	24	23.9
3	15.6	11.5	20.9	21.4				
4						19.8	20.8	20.8
6	22.5	23.1	21.1		24.1	24.3	20.9	23.7
9						21.1	21.2	20.8
10	0.5	1.5	1.1		2.8	1	0.9	0.8

NOTE: Permit Standard is 1.5 mg/l as a monthly average for May-October.
This standard applies to Site 10.

TABLE F-5, Results of Cyanide Analyses
WILLOW GROVE ARF WASTEWATER SURVEY
15-26 July 1991
(All Concentrations in mg/l)

SITE	18 Jul	19 Jul	20 Jul	Dup 20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
2						0.012	0.006	0.009
3	<0.005	<0.005	<0.005	<0.005				
4						<0.005	<0.005	<0.005
6	0.008	0.01	0.006		0.01	<0.005	<0.005	<0.005
9						0.01	<0.005	0.008
10	0.007	0.006	<0.005		<0.005	<0.005	<0.005	<0.005

TABLE F-6, Results of Phenol Analyses WILLOW GROVE ARF WASTEWATER SURVEY 15-26 July 1991 (All Concentrations in ug/l)							
SITE	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
6	25	120	27	73	35	18	45
10	<10	<10	10	<10	10	10	10

TABLE F-7, Results of Total Residue Analyses WILLOW GROVE ARF WASTEWATER SURVEY 15-26 July 1991 (All Concentrations in mg/l)							
SITE	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
6	469	512	408	1639	447	423	491
10	405	469	456	419	6	388	399

TABLE F-8, Results of Phosphorus Analyses WILLOW GROVE ARF WASTEWATER SURVEY 15-26 July 1991 (All Concentrations in mg/l)							
SITE	18 Jul	19 Jul	20 Jul	21 Jul	23 Jul	24 Jul	25 Jul
6	5.2	6.4	4.7	2.6	5	3.1	5.8
10	2	2.3	2.4	2.7	2.4	2.4	2.7

NOTE: The Permit standard for phosphorus is 2.0 mg/l as a monthly average. This standard applies to Site 10.

TABLE F-9, Results of Total Toxic Organics (TTO) Analyses (Table 1 of 3) WILLOW GROVE ARF WASTEWATER SURVEY 23 July 1991 (All Concentrations in ug/l)		
EPA Method 608		
ANALYTE	Site 6	Site 10
Aldrin	<0.02	<0.02
alpha-BHC	<0.02	<0.02
beta-BHC	<0.02	<0.02
delta-BHC	<0.02	<0.02
gamma-BHC	<0.02	<0.02
Chlordane	<0.16	<0.16
DDD	<0.02	<0.02
DDE	<0.02	<0.02
p,p-DDT	<0.02	<0.02
Dieldrin	<0.02	<0.02
Endosulfan I	<0.02	<0.02
Endosulfan II	<0.02	<0.02
Endosulfan sulfate	<0.02	<0.02
Endrin	<0.02	<0.02
Endrin aldehyde	<0.02	<0.02
Heptachlor	<0.02	<0.02
Heptachlor epoxide	<0.02	<0.02
Toxaphene	<1.0	<1.0
Aroclor 1016	<0.2	<0.2
Aroclor 1221	<0.2	<0.2
Aroclor 1232	<0.2	<0.2
Aroclor 1242	<0.2	<0.2
Aroclor 1248	<0.2	<0.2
Aroclor 1254	<0.2	<0.2
Aroclor 1260	<0.2	<0.2
Endrin Ketone	<0.02	<0.02
Methoxychlor	<0.02	<0.02

TABLE F-9, Results of Total Toxic Organics (TTO) Analyses (Table 2 of 3) WILLOW GROVE ARF WASTEWATER SURVEY 23 July 1991 (All Concentrations in ug/l)		
EPA Method 624		
ANALYTE	Site 6	Site 10
Benzene	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0
Bromoform	<5.0	<5.0
Bromomethane	<10.0	<10.0
Carbon Tetrachloride	<5.0	<5.0
Chlorobenzene	<5.0	<5.0
Chloroethane	<10.0	<10.0
Chloroform	<5.0	<5.0
Chloromethane	<10.0	<10.0
2-Chloroethylvinyl ether	<10.0	<10.0
Chlorodibromomethane	<5.0	<5.0
1,1-Dichloroethane	<5.0	<5.0
1,2-Dichloroethane	<5.0	<5.0
1,1-Dichloroethene	<5.0	<5.0
Trans-1,2-Dichloroethene	<5.0	<5.0
1,2-Dichloropropane	<5.0	<5.0
Cis-1,3-Dichloropropene	<5.0	<5.0
Trans-1,3-Dichloropropene	<5.0	<5.0
Ethyl Benzene	<5.0	<5.0
Methylene Chloride	<5.0	<5.0
1,1,2,2-Tetrachloroethane	<5.0	<5.0
Tetrachloroethylene	<5.0	<5.0
Toluene	<5.0	<5.0
1,1,1-Trichloroethane	<5.0	<5.0
1,1,2-Trichloroethane	<5.0	<5.0
Trichlorofluoromethane	<5.0	<5.0
Vinyl chloride	<10.0	<10.0
Trichloroethylene	<5.0	<5.0
Acetone	<100	<100
Carbon Disulfide	<5.0	<5.0
Acrolein	<50	<50
Acrylonitrile	<50	<50
Methyl Ethyl Ketone	<100	<100
Vinyl Acetate	<10.0	<10.0
Methyl Isobutyl Ketone	<50	<50
2-Hexanone	<50	<50
Styrene	<5.0	<5.0
Xylenes (Total)	<5.0	<5.0

TABLE F-9, Results of Total Toxic Organics (TTO) Analyses (Table 3 of 3) WILLOW GROVE ARF WASTEWATER SURVEY 23 July 1991 (All Concentrations in ug/l)		
EPA Method 625		
ANALYTE	Site 6	Site 10
p-Chloro-m-cresol	<10.0	<10.0
2-Chlorophenol	<10.0	<10.0
n-Nitrosodimethylamine	<10.0	<10.0
Phenol	<10.0	<10.0
Bis(2-chloroethyl)ether	<10	<10
1,3-Dichlorobenzene	<10	<10
1,4-Dichlorobenzene	<10	<10
Benzyl Alcohol	<10.0	<10.0
1,2-Dichlorobenzene	<10	<10
2-Methylphenol	<10.0	<10.0
4-Methylphenol	<10.0	<10.0
n-Nitrosodi-n-propylamine	<10.0	<10.0
Hexachloroethane	<10.0	<10.0
Nitrobenzene	<10.0	<10.0
Isophorone	<10.0	<10.0
2-Nitrophenol	<10.0	<10.0
2,4-Dimethylphenol	<10.0	<10.0
Benzoic Acid	<50	<50
Bis(2-chloroethoxy)methane	<10	<10
2,4-Dichlorophenol	<10.0	<10.0
1,2,4-Trichlorobenzene	<10.0	<10.0
Naphthalene	<10.0	<10.0
4-Chloroaniline	<10.0	<10.0
Hexachlorobutadiene	<10.0	<10.0
2-Methyl Naphthalene	<10.0	<10.0
Hexachlorocyclopentadiene	<10.0	<10.0
2,4,6-Trichlorophenol	<10.0	<10.0
2,4,5-Trichlorophenol	<50	<50
2-Chloronaphthalene	<10	<10
2-Nitroaniline	<50	<50
Dimethyl Phthalate	<10	<10
Acenaphthalene	<10	<10
3-Nitroaniline	<50	<50
Acenaphthene	<10	<10
2,4-Dinitrophenol	<50	<50
4-Nitrophenol	<50	<50
Dibenzofuran	<10.0	<10.0
2,6-Dinitrotoluene	<10	<10
2,4-Dinitrotoluene	<10	<10
Diethyl Phthalate	<10	<10
4-Chlorophenyl phenyl ether	10	10
Fluorene	<10	<10
4-Nitroaniline	<50	<50
4,6-Dinitro-o-cresol	<50	<50
n-Nitrosodiphenylamine	<10.0	<10.0
4-Bromphyenyl phenyl ether	<10	<10
Hexachlorobenzene	<10.0	<10.0
Pentachlorophenol	<50	<50
Phenanthrene	<10.0	<10.0
Anthracene	<10	<10
di-n-Butyl phthalate	<10	<10
Fluoranthene	<10	<10
Benzidine	<50	<50
Pyrene	<10.0	<10.0
Butyl benzyl phthalate	<10	<10
3,3-Dichlorobenzidine	<20	<20
Benzo[a]anthracene	<10	<10
Bis(2-ethylhexyl)phthalate	<10	<10
Chrysene	<10	<10
di-n-Octyl-phthalate	<10	<10
Benzo[b]fluoranthene	<10	<10
Benzo[k]fluoranthene	<10	<10
Benzo[a]pyrene	<10	<10
Indeno(1,2,3-cd)pyrene	<10	<10
Dibenzo(ah)anthracene	<10	<10
Benzo(ghi)perylene	<10	<10
Bis(2-chloroisopropyl)ether	<10	<10

APPENDIX G

STORM WATER SAMPLING RESULTS

TABLE G-1, Results of Volatile Organic Analyses for Site 11, Storm Water Holding Pond
WILLOW GROVE WASTEWATER SURVEY
15 - 26 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons:	
	24 Jul
Bromodichloromethane	<0.4
Bromoform	<0.4
Carbon Tetrachloride	<0.5
Chlorobenzene	<0.6
Chloroethane	<0.9
Chloroform	<0.3
Chloromethane	<0.8
Chlorodidromomethane	<0.5
1,2-Dichlorobenzene	<1.0
1,3-Dichlorobenzene	<0.5
1,4-Dichlorobenzene	<0.7
Dichlorodifluoromethane	<0.9
1,1-Dichloroethane	<0.4
1,2-Dichloroethane	<0.3
1,1-Dichloroethene	<0.3
Trans-1,2-Dichloroethene	<0.5
1,2-Dichloropropane	<0.3
Cis-1,3-Dichloropropene	<0.5
Trans-1,3-Dichloropropene	<0.5
Methylene Chloride	<0.4
1,1,2,2-Tetrachloroethane	<0.5
Tetrachloroethylene	1.8
1,1,1-Trichloroethane	<0.5
1,1,2-Trichloroethane	<0.5
Trichloroethylene	<0.5
Trichlorofluoromethane	<0.4
Vinyl Chloride	<0.9
2-Chloroethylvinyl Ether	<0.9
Bromomethane	<0.9
Volatile Organic Aromatics:	
1,3-Dichlorobenzene	0.4
1,4-Dichlorobenzene	<0.7
Ethyl Benzene	<0.3
Chlorobenzene	<0.6
Toluene	<0.3
Benzene	<0.5
1,2-Dichlorobenzene	<1.0

TABLE G-2, Results of Metals Analyses
for Site 11, Storm Water Holding Pond
WILLOW GROVE WASTEWATER SURVEY
15 - 26 JULY 1991

ANALYTE	UNITS:	24 Jul
Antimony	ug/l	<10
Arsenic	ug/l	<10
Barium	ug/l	<100
Beryllium	ug/l	<10
Boron	ug/l	<200
Cadmium	ug/l	<10
Calcium	mg/l	14
Chromium	ug/l	<50
Chromium VI	ug/l	HTE
Copper	ug/l	<20
Iron	ug/l	633
Lead	ug/l	<20
Magnesium	mg/l	3.2
Manganese	ug/l	464
Mercury	ug/l	<1
Nickel	ug/l	<50
Potassium	mg/l	2.2
Selenium	ug/l	<10
Silver	ug/l	<10
Sodium	mg/l	3.7
Thallium	ug/l	<10
Zinc	ug/l	<50

HTE = Holding Time Exceeded

TABLE G-3, Results of Miscellaneous Analyses for Site 11, Storm Water Holding Pond WILLOW GROVE WASTEWATER SURVEY 15 - 26 JULY 1991			
ANALYTE	UNITS:	Literature Value*	24 Jul
Ammonia	mg/l		<0.2
Kjehldahl Nitrogen	mg/l		1.3
Nitrates (as N)	mg/l	3-10	0.31
Nitrites (as N)	mg/l		<0.02
Orthophosphate	mg/l		<0.1
Phosphorus, Total	mg/l	0.6	0.1
Phenol	ug/l		<10.0
Residue, Total	mg/l		86
Surfactants (MBAS)	mg/l		<0.1
Oils and Grease	mg/l		0.3
Total Hydrocarbons	mg/l		<1.0
pH			6.5
Temperature	deg C		25
COD	mg/l	20-600	55
BOD	mg/l	10-250	

* From Novotny and Chesters (9)

APPENDIX H

OIL/WATER SEPARATOR SAMPLING RESULTS

215-489-3131
FAX 215-489-8933

Art Rambo & Son

235 Centenial Road
Rahns, PA 19426
Federal I.D. #23-2244699

POLLUTION CONTROL
TANK CLEANING — BURNER SERVICE
CONSULTING — EQUIPMENT — SERVICES

Willow Grove Naval Air Station
111th TASG
Willow Grove, Pa. 19090
443-1346, Fax 443-1871
Attention: Lt. Col. Rothert & Sgt. Covolosky

July 12, 1991

Dear Sirs,

I am pleased to quote you on the testing and cleaning of your oil separators.

Art Rambo & Son will supply all of the skilled labor, and material necessary to complete the following work:

1. Labor to take 4 liquid samples and transport samples to testing facility.

Price For #1: $200.00

2. Have the liquid samples checked for the following:

8 Heavy Metals	$188.64/Sample X 4 Samples=	$754.56
PCB's	$141.48/Sample X 4 Samples=	$565.92
BTEX	$117.90/Sample X 4 Samples=	$471.60
Flashpoint	$ 38.91/Sample X 4 Samples=	$155.64
Ph	$ 11.79/Sample X 4 Samples=	$ 47.16

TOTAL FOR LIQUID SAMPLE TESTING: $1994.88*

*Please Note: Testing prices are for normal turnaround (21 working days). If you would like 48 hour turnaround all testing prices will be doubled.

3. Pump out tanks at the following buildings: #320, #330, #350, #353, and kitchen building with two grease traps. The tanks will then be flushed with a pressure washer.
Pump out the 3 separate storage tanks for the separators. Flush the storage tanks with #2 oil.

Price For #3: $1500.00**

**This price does not include disposal; those prices will be given after the test results are received. Please note: the liquids will be handled in bulk (to reduce cost), and the solids will be drummed.

4. (After the tank testing is completed) Pump out and dispose of the water.

Prices For #4: Water Disposal 80¢ per gallon.
Vacuum Truck w/Driver (estimated 5 hours)
at $75.00 per hour= $375.00

TERMS: 2% 10 Days, Net 30

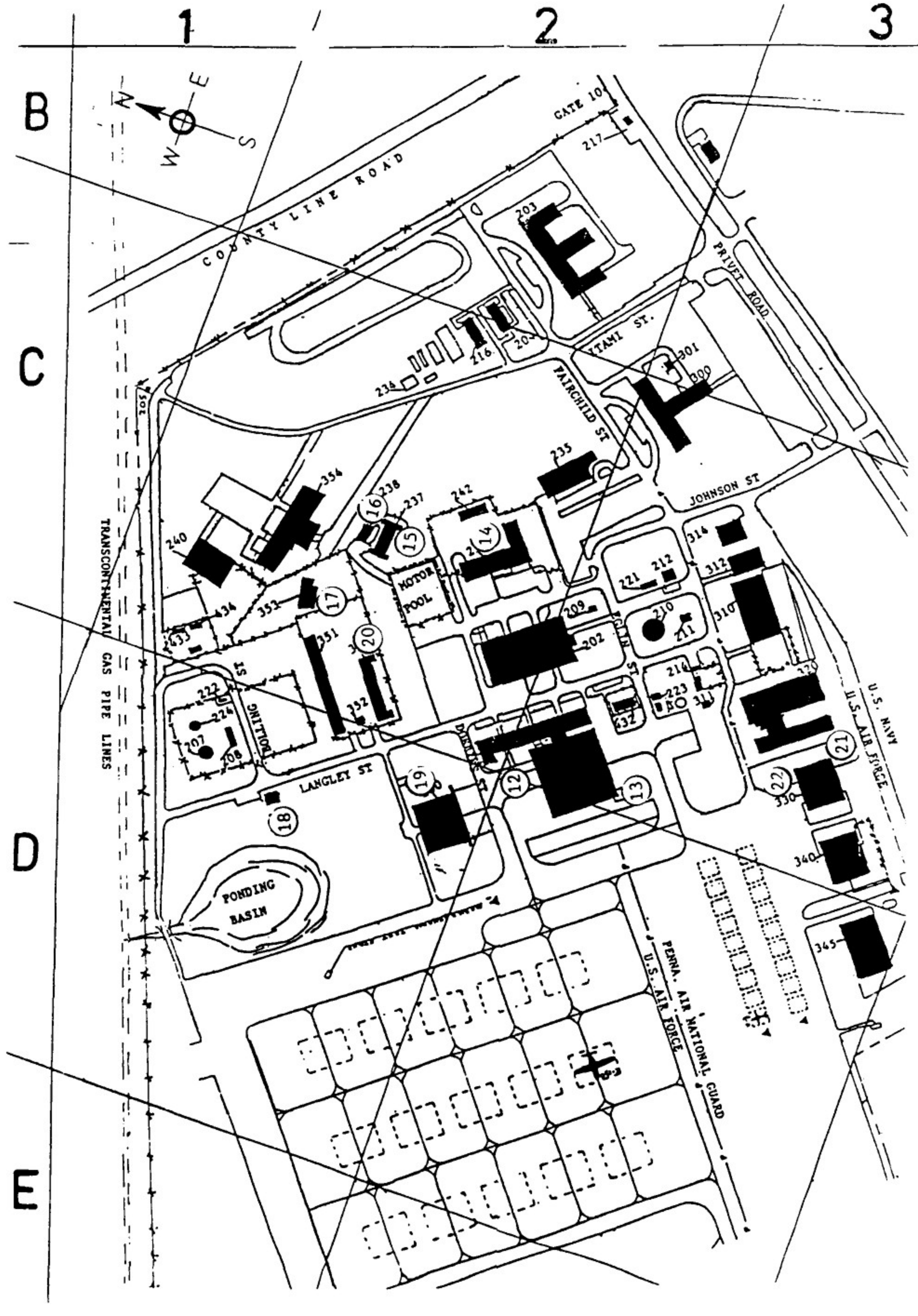

Figure H-1. Locations of the Oil/Water Separator Sites.

TABLE H-1, Results of EPA Method SW 8010 and SW 8020 Analysis for the Outfalls of the Oil/Water Separator Sites
WILLOW GROVE ARF WASTEWATER SURVEY
24 JULY 1991
(All Concentrations in ug/l)

Volatile Organic Hydrocarbons (EPA Method SW 8010):			
Analyte	Site 12	Site 13	Site 17*
Bromodichloromethane	<0.4	<0.4	
Bromoform	<0.7	<0.7	
Carbon Tetrachloride	<0.5	<0.5	
Chlorobenzene	<0.6	<0.6	
Chloroethane	<0.9	<0.9	
Chloroform	<0.3	<0.3	
Chloromethane	<0.8	<0.8	
Chlorodibromomethane	<0.5	<0.5	
1,2-Dichlorobenzene	<1.0	<1.0	
1,3-Dichlorobenzene	<0.5	<0.5	
1,4-Dichlorobenzene	<0.7	<0.7	
Dichlorodifluoromethane	<0.9	<0.9	
1,1-Dichloroethane	<0.4	<0.4	
1,2-Dichloroethane	<0.3	<0.3	
1,1-Dichloroethene	<0.3	<0.3	
Trans-1,2-Dichloroethene	<0.5	<0.5	
1,2-Dichloropropane	<0.3	<0.3	
Cis-1,3-Dichloropropene	<0.5	<0.5	
Trans-1,3-Dichloropropene	<0.5	<0.5	
Methylene Chloride	<0.4	<0.4	
1,1,2,2-Tetrachloroethane	<0.5	<0.5	
Tetrachloroethylene	<0.6	<0.6	
1,1,1-Trichloroethane	<0.5	<0.5	
1,1,2-Trichloroethane	<0.5	<0.5	
Trichloroethylene	<0.5	<0.5	
Trichlorofluoromethane	<0.4	<0.4	
Vinyl Chloride	<0.9	<0.9	
2-Chloroethylvinyl Ether	<0.9	<0.9	
Bromomethane	<0.9	<0.9	
Volatile Organic Aromatics (EPA Method SW 8020):			
1,2-Dichlorobenzene			<5.0
1,3-Dichlorobenzene			<5.0
Ethyl Benzene			<5.0
Toluene			<5.0
Chlorobenzene			NP**
o-Xylene			NP
m-Xylene			NP
p-Xylene			NP
Xylenes			<5.0
1,4-Dichlorobenzene			<5.0
Benzene			<5.0

* Sample taken at holding tank for Waterfall Paint Booth.

** NP = Analysis not performed.

TABLE H-2, Results of Hazardous Waste Analyses for
the Oil Layer on the Influent Side of the Oil/Water Separator Sites
WILLOW GROVE ARF WASTEWATER SURVEY
24 JULY 1991

ANALYTE	UNITS:	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21
Arsenic	ug/l	<100	<100	<100	<100	<100	<100	400	<100
Barium	ug/l	900	300	<100	200	<100	<100	200	<100
Cadmium	ug/l	<50	<50	<50	<50	<50	<50	<50	<50
Chromium	ug/l	100	<100	<100	<100	<100	<100	400	<100
Lead	ug/l	300	<100	<100	<100	<100	100	1700	<100
Mercury	ug/l	<10	<10	<10	<10	<10	<10	<10	<10
Selenium	ug/l	<100	<100	<100	<100	<100	<100	400	<100
Silver	ug/l	<20	<20	<20	<20	<20	40	<20	<20
1,2-Dichlorobenzene	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	<80	<5.0
1,3-Dichlorobenzene	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	<80	<5.0
Ethyl Benzene	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	990	<5.0
Toluene	ug/l	5	440	<5.0	<5.0	<5.0	<5.0	4900	<5.0
Chlorobenzene	ug/l	NP*	NP	NP	NP	NP	NP	NP	NP
o-Xylene	ug/l	NP	NP	NP	NP	NP	NP	NP	NP
m-Xylene	ug/l	NP	NP	NP	NP	NP	NP	NP	NP
p-Xylene	ug/l	NP	NP	NP	NP	NP	NP	NP	NP
Xylenes	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	<80	<5.0
1,4-Dichlorobenzene	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	1800	<5.0
Benzene	ug/l	<5.0	<20	<5.0	<5.0	<5.0	<5.0	6100	<5.0
Flashpoint	deg F	>140	>140	>140	>140	>140	>140	125.6	>140
Aroclor 1016	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
Aroclor 1221	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
Aroclor 1232	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
Aroclor 1242	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	20	<1.0
Aroclor 1248	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
Aroclor 1254	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
Aroclor 1260	mg/kg	<2.0	<10.0	<1.0	<1.0	<1.0	<10.0	<10.0	<1.0
pH		6.4	5.1	7.1	7.4	4.6	5.8	8.3	6.6

* NP = Analysis Not Performed.

TABLE H-3, Results of Hazardous Waste Analyses for the Water on the Outfall Side of the Oil/Water Separator Sites
WILLOW GROVE ARF WASTEWATER SURVEY
24 JULY 1991

ANALYTE	UNITS:	Site 12	Site 13	Site 14	Site 15	Site 17	Site 19
Arsenic	ug/l	<10	<10	<10	<10	<100	<10
Barium	ug/l	<100	<100	148	<100	100	<100
Beryllium	ug/l	<10	<10	<10	<10		<10
Cadmium	ug/l	<10	<10	<10	<10	<50	<10
Chromium	ug/l	<50	<50	<50	<50	<100	<50
Chromium VI	ug/l	HTE	HTE	HTE	HTE	HTE	HTE
Copper	ug/l	20	<20	<20	<20		<20
Iron	ug/l	37200	<100	9800	588		<100
Lead	ug/l	<20	<20	<20	<20	<100	<20
Magnesium	mg/l	5.8	1.6	23.4	2.5		1.4
Manganese	ug/l	476	<50	190	78		<50
Mercury	ug/l	<1	<1	<1	<1	<10	<1
Nickel	ug/l	<50	<50	<50	<50		<50
Selenium	ug/l	<10	<10	<10	<10	<100	<10
Silver	ug/l	<10	<10	<10	<10	<20	<10
Thallium	ug/l	<10	<10	<10	<10		<10
Zinc	ug/l	417	245	508	<50		<50
Flashpoint	deg F					>140	
Aroclor 1016	mg/kg					<1.0	
Aroclor 1221	mg/kg					<1.0	
Aroclor 1232	mg/kg					<1.0	
Aroclor 1242	mg/kg					<1.0	
Aroclor 1248	mg/kg					<1.0	
Aroclor 1254	mg/kg					<1.0	
Aroclor 1260	mg/kg					<1.0	
pH						7.8	

HTE = Holding Time Exceeded

TABLE H-4, Results of Oils and Greases and Total Petroleum Hydrocarbon Analysis for the Outfalls of the Oil/Water Separator Sites
WILLOW GROVE ARF WASTEWATER SURVEY
24 JULY 1991
(All Concentrations in mg/l)

Analyte	Site 12	Site 13	Site 14	Site 15	Site 19
Oils and Greases	15.4	<0.3	1.3	4.6	<0.3
Total Pet. Hydrocarbons	15.4	<1.0	<1.0	4.6	1.0

*U.S. GOVERNMENT PRINTING OFFICE 1992 0 661 049 60014